Electrical World

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Electrical World

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Getting Fresh Capital

IT IS an axiom often quoted in the industry that growing public utility electric properties need a supply of fresh capital periodically to meet the cost of plant enlargement. Executives of companies fully appreciate the importance of this and they continue to emphasize it in a way which seems superfluous to those who do not bear the responsibility of providing funds for development. They understand, however, that it is really an element in company management on which the public still needs knowledge. Credit is the basis of the financing progress of a public utility, and in order to keep the plane of credit a high one they encourage a public appreciation of the situation. With the conditions that follow the war there is special reason for laying heavy stress upon the need of the companies for an uninterrupted flow of investment money to their treasuries. This is one of the issues on which educational publicity is helpful. The commissions can assist in maintaining sound conditions in the entire field of public utility service by showing that they recognize the value of stable earnings, a stable return on the existing capital investment and reasonable assurance of protection and fair return on the new capital which is so greatly desired. This is a work in which the commissions will render undoubted service to the general consuming public. High quality of service and a steady progress which keeps step with the advance of a live community are more certain to be secured from company solvency than from bankruptcy.

By whatever means the financing of public utilities is arranged in the next few years of shifting international affairs, the coöperation of the companies and the commissions representing the public will tend to reduce the cost of borrowing and hence capital charge on the investment. The world has spent capital lavishly to safeguard human ideals. It now needs stupendous sums for restoration. It must have great stocks of raw and manufactured products. The demand for credits from foreign buyers who seek our goods will reach huge totals. Requirements for normal expansion of our own industries will be large. Public utility borrowings on a great scale will be necessary to prepare for the future calls for light and power service. When the full measure of world-wide capital needs is surveyed even roughly, it can be seen that conservation is as necessary here as in raw fuel and power resources. What the companies can do on their part to lessen the possibility of a strained world-credit position is to watch their capital requirements with painstaking care, to restrict their borrowing to essential betterments and additions, and to keep the rate of interest on bonds or dividends on stock and the prices of securities sold at levels which accord with present-day standards. Commissions can help to make it simple for well-managed companies to maintain the strength of their credit standing with bankers. This is not alone a matter of authorizing adequate rate increases where those are necessary; it will be in part a question of helping the companies, especially small properties, to get the most economical service from their plants, to effect interconnection where that means a saving, and to fill the natural economic place in the community of supplier of energy for all.

All conditions affecting the capital investment of the central station are in fact much altered. The real value of the standing plant investment is far greater than in 1914. Costs of materials and labor on the post-war scale put a figure of replacement value on the physical properties to-day that would not have been thought possible before the war. Similarly, new investment in plant at 1919 prices means an outlay which dollar for dollar yields less in generating and distributing capacity. The business of the central-station properties will not shrink back to the old level. Not only is the permanence of the great bulk of present load pretty well assured because coal and labor conditions still harass isolated plant operation, but more and more will customers be drawn by the increasing appreciation of the economic fact that concentration in power generation and distribution is advantageous for the users of the whole community. That this situation calls in the public interest for the maintenance of the physical and credit position of the properties by willing agreement of all concerned is plain to the industry and it should be plain to those who have jurisdiction over the companies.

Dwelling-house construction is going ahead in many communities for the same reason that will lead to other forms of construction—necessary work must be done. Housing accommodations are badly needed and lack of facilities for the enlarging requirements of industry will force commercial construction.

A National Project for Power Transmission

PLANS laid in Great Britain and Japan which look forward to a unified power supply were referred to recently in these columns. In the current issue George F. Paul describes a striking general project covering the whole of Spain. The feature which renders it especially interesting is that it has been planned as a whole with a view to a country-wide utilization of water powers for industrial purposes. There have already been utilized many hydraulic privileges in Spain, particularly among the Pyrenees on the northern border. Only the other day an advertisement appeared

in one of the London papers offering cheap power from a Spanish plant near this frontier. The present plan, however, looks to a complete development, and the commission charged with the task of formulating it has counted up no less than 2,000,000 available hp., three quarters of it in units capable of producing more than 2000 hp. each. Of this roughly a half lies near the northern border, perhaps a quarter in central Spain, and the rest is somewhat scattered. To utilize this power and bring it all into industrial service a complete scheme of development at standard frequency has been worked out. The frequency chosen is 50 cycles, already standard in Spain, and the plans include nearly 2000 miles (3220 km.) of line, ranged, as shown in the map, substantially as a ring around the entire country with radial lines tapping this ring and centering at Madrid, together with branches reaching to the coast of the northwest provinces. The transmission in this great project is to be at 120,000 volts or more, three-phase, and the total cost of the great network is figured at only about $25,000,000 ready for operation.

It is proposed to encourage the use of the system by enterprises which desire to furnish or take power, subject to regulations prescribed by the Minister of Public Works, and to stimulate the development of all the available water powers for connection with the general system. Beside the water powers Spain also has several large deposits of low-grade coal, which could readily be utilized for big power plants situated at the mouth of the mines.

We have been accustomed to think of that country as rather slow and easy-going, but certainly the plan here described is concrete evidence to the contrary. It would not be surprising to see this great national enterprise carried out before our own projects of a similar sort have advanced beyond the stage of committee hearings and legislative wrangling.

Securities of established electric utilities are finding markets at rates which are high but are, when one considers the cost paid by our own powerful national government, nevertheless in accord with the going figures in the money market. Bond dealers are looking for mortgage obligations of sound well-known properties at the present high rates.

Responsibility of Large Companies

WHEN the gas company of Chicago permitted "curbstone" meter reading to incense patrons against it, it damaged the public relations of many utility companies within 500 miles of Chicago. The damage was actual. In Oskaloosa, Iowa, for instance, the number of customers' complaints increased 500 per cent within a week after the story of the gas case was published in the Chicago newspapers. What happened in Oskaloosa also happened in other cities and towns reached by the Chicago papers. Unjustified complaints, harder to handle because unjust, increased everywhere. Thus the errors of one large company showed effects not only in its own territory but also in a vast field where other companies were straining under severe handicaps to maintain service of high quality.

This incident illustrates why large utilities should feel a sense of responsibility to the industry. By the acts of a few important concerns the business morals of a whole industry are often judged.

The New Kern River Development

ENGINEERING novelties come from the Coast so frequently that G. E. Armstrong's account of the unusual features of the new Kern River plant of the Southern California Edison Company will be regarded with more of genuine interest than surprise. The present installation, held up by the war and pushed rapidly since the signing of the armistice, will be in operation by the early summer of 1920. The new plant will be known as Kern River plant No. 3. In addition a 16,000-kw. generator will be put upon the general circuits at Big Creek plant No. 2. The peculiarities of Kern River plant No. 3 are both hydraulic and electric. The necessity of economizing water to the utmost under somewhat unusual conditions instigated the use of Francis turbines instead of the customary impulse wheels, even although the head is 800 ft. (245 m.), quite the highest attempted with prime movers of this type. Each wheel is of 22,500 hp. and each is provided with two runners and distributers, one adapted for maximum efficiency at 500 r.p.m., the other at 600 r.p.m. This double speed is for the purpose of operating the generators at either 50 cycles to fit the regular system or 60 cycles supplying power to the Mount Whitney Power & Electric Company and the San Joaquin Light & Power Corporation, which operate at this frequency. The interrelation between these companies has already been described in our columns. The use of turbines rather than impulse wheels would appear under these circumstances to be advisable on the score both of efficiency and simplicity, since for units of this size an impulse-wheel system arranged for two speeds of maximum efficiency would be unpleasantly cumbersome. So much for the hydraulic features of the plant.

From the electrical standpoint still other unusual conditions had to be met. The Kern River line taps the main transmission of 241 miles (388 km.) from Big Creek to the Eagle Rock substation at the receiving end, not very far from midway. At the Richgrove substation the line connecting this with Kern River plant No. 3 is about 45 miles (72 km.) in length and will be operated at 75,000 volts over a double-circuit tower line feeding into the 150,000-volt main transmission through transformers. At Richgrove is a frequency changer of 15,000 kva. permitting interchange of power between the main lines and the 60-cycle subsidiaries. At the Eagle Rock station a 30,000-kva. synchronous condenser will be added to the two 15,000-kva. units already in use for voltage regulation.

The Kern River generators are operated part of the time at 50 cycles in parallel with the Big Creek plants, and part of the time one or both of the units will work at 60 cycles feeding into the subsidiary lines at this frequency. In addition an unusual duty is imposed upon the plant of carrying one circuit of the long Big Creek line independently without help from the synchronous condensers and without substantial load. For this purpose the Kern River generators were designed to give their full kva. output either at normal voltage with a power factor of about 91 per cent or at 56 per cent of normal voltage with power factor leading, to meet the condition just mentioned of dealing with the long and lightly loaded line with about 17,000 kva. charging current. Automatic voltage regulators will keep the initial pressure steady at either of the required voltages. The generators are of the vertical shaft type with the somewhat unusual feature of hav-

ing the thrust bearing at the top. It will thus be seen that the new plant involves some very unusual features thrust upon it by the unique conditions of the loading, and news of its operation will therefore be watched for with peculiar interest.

Advances in prices of automobile passenger cars and trucks and further increase in copper quotations are signs to be observed. Cars and trucks cost more to produce. Copper is affected by a number of influences —labor, accumulated output in the hands of a few producers, natural reaction from a heavy decline, etc. Watch the cost curves!

Current in Armature Conductors

IN the design of large induction motors it is desirable to secure a relatively large secondary resistance during the operation of starting, because the magnitude of the starting torque depends directly upon this resistance. External starting resistances are commonly resorted to for the purpose of increasing the secondary circuit resistances by auxiliary means. On the other hand, it is also desirable that the secondary resistances should be relatively low during full-speed operation, because the speed regulation and the efficiency are thus improved. If an induction motor is operated from 60-cycle mains, the frequency of the currents in the secondary windings will be 60 cycles per second at standstill but will diminish to mere slip frequency at full speed. This condition is utilized in some designs by employing secondary conductors in which considerable extra resistance from skin effect will be set up at starting frequencies, but this extra resistance will practically all disappear at running frequencies. Consequently, it becomes important to study the phenomena of skin effect in large copper conductors, in order the more effectively to utilize this principle in the design of induction motors.

The article by Prof. Waldo V. Lyon in our last issue bears strongly on the principles of skin effect in rectangular copper conductors embedded in the open slots of laminated-steel armature bodies. In such cases the magnetic flux may be regarded, at least to a first approximation, as passing straight across from one wall of the slot to the other, through the substance of the copper bar. The density of this flux, due to alternating currents in the bar, naturally attains a maximum at the outer surface of the bar, and reaches zero at the bottom of the bar, in the lowest parts of the slot. The return flux is supposed to be all carried by the walls of the slot, with inappreciable leakage and also relatively small hysteretic lag or loss. Under these conditions, the formulas controlling skin-effect extra resistance, at any given frequency, become relatively easily managed. They are developed in the article. If, however, the same bar is surrounded by air or other non-magnetic material, the flux paths through the copper deviate considerably from straight lines, and edge effect presents itself, with greatly increased mathematical difficulties.

In the case considered the conductor, if sufficiently massive, virtually behaves as though its depth were reduced from the actual dimension to a certain equivalent skin depth, which varies inversely as the square root of the frequency of the currents carried, so that the virtual depth of the conductor at 60 cycles is only half of that at 15 cycles.

Although the extra resistance of skin effect is much easier to compute when edge effect is absent, yet the presence of edge effect adds considerably to the extra resistance. For that reason a strip or strap of copper supported in air on insulators is apt to develop a very appreciable extra resistance from edge effect when in large sizes, even at frequencies as low as 25 cycles per second.

In the light of the failure of the telegraphers' strike it is difficult to see why the government was justified in taking over the wire systems last year on the ground that a tie-up could not be risked during the war emergency. Public sentiment would have killed any such movement at once, and the government would have been spared the consequences of one of its greatest blunders in the war period. Hindsight again, instead of the vision rightly demanded of statesmen!

Electric Steel Furnace Operation

UNDER war conditions there has been a great awakening as to the possibilities of electric melting and refining of steel, and we are glad to be able to publish in brief the results obtained in the operation of eighteen steel furnaces in the Milwaukee industrial district, ranging in normal capacity from one ton to twelve tons. All are of the arc type, and of the total number ten are three-phase, six single-phase, and two two-phase, representing five different forms of furnace. The larger part of the group in numbers and output are three-phase four-wire furnaces, the three phases being connected to three vertical electrodes pointing downward, while the neutral connects to the bottom of the furnace and tends greatly to steady the balance between the phases. There are two other three-phase furnaces of the type without neutral connection; the others are small furnaces, single-phase or two-phase.

The tendency of experience in the operation of all these furnaces has been to push the melt more rapidly than was the earlier practice, calling for a considerably heavier output from the transformers at times, but working somewhat more efficiently and giving increased daily output. Most of the three-phase furnaces are equipped with provision for dropping the arc voltage from 110 to 55 for the refining process. Two of the furnaces carry transformers of 3000 kva. capacity. Four of the group are running on basic steel. The load factors are rather low, the highest figure touched being 55 per cent and the average in the neighborhood of 30. The tabulated data give no information as to power factor, but this runs from as low as 40 per cent to nearly 90 per cent, the three-phase furnaces having the advantage in this respect. In general, the total kilowatt-hours used per ton run from 600 to 800, the higher figure being reached by two of the plants making basic and refined steel during the last year and hence consuming somewhat more energy. Where the charge does not require refining, as in many of the cases of steel for castings, a single furnace can pour twelve melts in a day, so that, despite the rather modest rating of most of those listed, the actual output can be keept up to a very respectable figure. The advantages of the electric furnace in the steel industry, particularly in certain classes of work, is very marked, and the results of operation here gathered show that this particular field of electric power is likely to prove a fertile one.

New Kern River Development

Southern California Edison Company Plant Calls for Francis Turbines to Operate Under Head of 800 Ft.—Two Turbines, Each with Two Runners and Distributers, Furnish 32,000 Kw. Energy of Either 50 Cycles or 60 Cycles Frequency at Maximum Efficiency

BY G. E. ARMSTRONG
Southern California Edison Company

ALMOST immediately after the signing of the armistice, the Southern California Edison Company proceeded with great vigor to the construction of generating equipment, transmission lines and auxiliary apparatus for the generation of 48,000 kw., in addition to its present installed capacity of 196,000 kw., so as to be in a position to supply the rapidly growing demands for power by the industrial and agricultural interests of central and southern California. During the war the construction on these works was necessarily proceeding at a comparatively slow rate. Pressing war needs and difficulty in obtaining material and labor made it almost impossible to devote much energy to new projects, although the additional energy was greatly needed. The plans for serving the needs of this section and for furnishing energy to subsidiary plants include the construction of a 32,000-kw. hydroelectric generating plant on Kern River and an additional 16,000-kw. generator in the Big Creek No. 2 plant. For voltage control at the receiving station near Los Angeles a 30,000-kva. synchronous condenser is to be installed, which will supplement the two present 15,000-kva. condensers in that station. At the Richgrove substation, which will be the terminal substation of the transmission line from the new Kern River plant, is to be installed a 15,000-kva. frequency changer for conversion from 50 cycles to 60 cycles, or vice versa. The Kern River power is to be transformed at Richgrove for transmission to Los Angeles over the 150,000-volt lines which are a part of the Big Creek transmission system. Plans are made and material is specified for shipment, so that these plants will be ready for full operation by the middle of 1920.

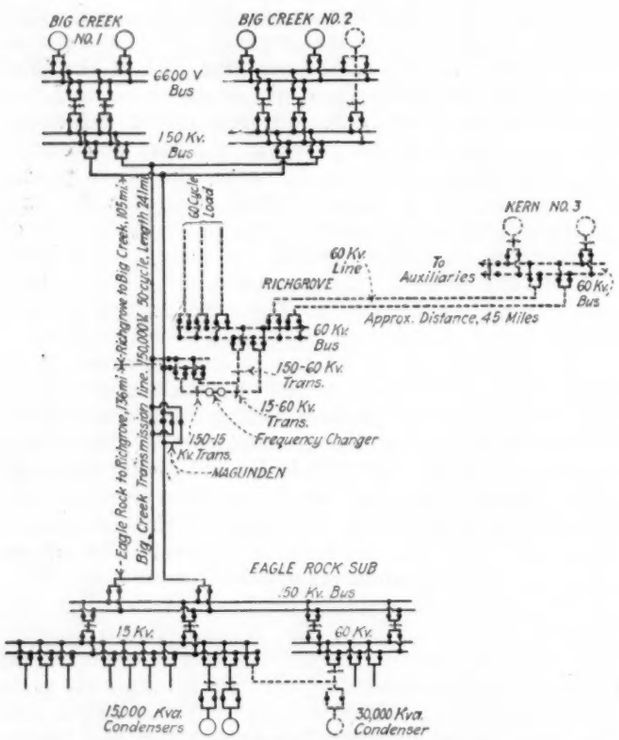


FIG. 1—SCHEMATIC DIAGRAM OF PART OF THE SYSTEMS OF THE SOUTHERN CALIFORNIA EDISON COMPANY, MOUNT WHITNEY POWER & ELECTRIC COMPANY AND SAN JOAQUIN LIGHT & POWER CORPORATION

Of particular interest in this program of construction is the Kern River No. 3 hydroelectric plant, which embodies new and distinctive features of mechanical and electrical design, the most important of which are the Francis type turbines operating under a head of 800 ft. (243 m.) and driving generators furnishing either 50-cycle or 60-cycle energy. In order to serve systems of different voltages, the generators are designed to deliver full output in kva. at normal voltage and 56 per cent of normal voltage. The former will be generated at lagging power factor and the latter (178 per cent normal current) at zero per cent power factor leading. Flexibility will be obtained by a unit arrangement of generators and transformers without low-tension switches and buses.

For an understanding of the load and system arrangements which made such a design of this plant desirable, the accompanying diagram (Fig. 1) of part of the system of the Southern California Edison Company, its subsidiary, the Mount Whitney Power & Electric Company, and the system of the San Joaquin Light & Power Corporation is shown. The Southern California Edison Company is operated at 50 cycles, while the Mount Whitney Power & Electric Company and the San Joaquin Light & Power Corporation are 60-cycle systems. The Southern California Edison Company supplies energy to its subsidiary and, owing to war conditions, interchanges with the San Joaquin Light & Power Corporation for the purpose of conservation of water and reducing the amount of fuel oil burned. For these reasons it is desirable to have the output of Kern River No. 3 available, with the maximum possible efficiency, at either 50 cycles or 60 cycles, or part at both frequencies.

GENERATORS GIVE EITHER 50-CYCLE OR 60-CYCLE ENERGY

To gain the best efficiency at each of the two speeds several alternative propositions were possible: First, the use of four complete units each of half the total possible output; second, waterwheels of one speed only and having two generators each of the capacity of the waterwheels, either or both operated continuously or having provision for disconnecting either from the turbine; third (the arrangement selected), two generators and two turbines with two runners and distributers for each wheel so that the turbines would have good efficiency at either 500 r.p.m. or 600 r.p.m.

In addition to the above arrangement for generation at Kern River No. 3 at either 50 cycles or 60 cycles, for

supplying power to the Mount Whitney Power & Electric Company and the San Joaquin Light & Power Corporation alternately with the system of the Southern California Edison Company, a 50-60-cycle frequency changer has been installed at Rihgrove, the terminal substation of the Kern River No. 3 lines. This machine is to be connected through 150,000/15,000-volt transformers to the 150,000-volt, 50-cycle Big Creek lines and through 15,000/60,000-volt transformers to the 60-cycle bus. Another bank of 150,000/60,000-volt transformers will connect the Big Creek lines to the 50-cycle bus. The two lines from Kern River No. 3 may be connected to either one or both of the buses at Richgrove. The scheme of operation in the winter months, when the pumping plant load on the Mount Whitney and the San Joaquin companies is light, is to run Kern River No. 3 at 50 cycles and transmit to Richgrove over the two lines and there step up from 60,000 volts to the 150,000-volt lines through the bank of three 11,500-kva. transformers. As summer approaches and the load on the 60-cycle systems begins to build up, the frequency changer will be used to deliver energy to the 60-cycle system. When this load equals half the capacity of one Kern River No. 3 machine, then the 60-cycle runner and distributer of one of the Kern River No. 3 turbines will be put in place and the unit run at 60 cycles, with transmission to Richgrove at 60 cycles on one line and 50 cycles on the other. The frequency changer will then deliver the excess of 60-cycle power to the 50-cycle system until the 60-cycle load requires the entire output of one Kern River No. 3 generator, after which the first cycle of operation will again be followed; finally, Kern River No. 3 will have both generators and lines operating at 60 cycles and the excess requirements, in either direction, passing through the frequency changer.

OPERATION VARIES WITH SEASONS

A more detailed description of the plant, which gives other features of the design and construction, will be found in the following paragraphs:

As noted above, the generators are to be built for operation at either 50 or 60 cycles, as the seasonal requirements demand. When operating at 60 cycles no unusual electrical features are encountered, as the full capacity will be transmitted at a distance of about 45 miles (72 km.) over two 60,000-volt lines to Richgrove. At Richgrove the 15,000-kva. frequency changer will be the connecting link with the 50-cycle Big Creek line; hence the daily voltage variation of the Big Creek line will not affect the 60-cycle system and the generating station will operate at practically constant voltage at 60 cycles.

When operating at 50 cycles Kern River No. 3 will be in parallel with the 150,000-volt Big Creek line through a bank of three 11,500-kva. transformers. At that time the operating conditions will be as follows:

(a) Kern River No. 3, delivering full output into the Big Creek lines in parallel with the Big Creek plants, with the wattless element of the line and the load being supplied by the synchronous condensers at the Eagle Rock substation at Pasadena. Under this condition each Kern River No. 3 unit must deliver 16,000 kw. or 17,500 kva. at 75,000 volts. The voltage on the Big Creek lines at Richgrove will be approximately 164,000.

(b) Kern River No. 3, delivering full output into the Big Creek lines, the Big Creek plants disconnected from the lines and the wattless element of the line and load supplied by the condensers. Under these conditions the voltage of the Big Creek lines at Richgrove will be approximately 145,000, and each unit at Kern River No. 3 must deliver 16,000 kw. (17,500 kva.) at 66,000 volts. This condition of operation will be obtained during low-load operation between midnight and morning.

(c) At certain times it may be necessary for one generating unit at Kern River No. 3 to carry one entire Big Creek line from Big Creek to Eagle Rock, a distance of 241 miles (390 km.) without load or without condensers or other plants being connected to that line. Under this condition it must be possible to control the voltage of the Kern River No. 3 plant so that the voltage of the Big Creek line at Eagle Rock will be 150,000, charging kva. at Kern River No. 3, 17,000, and the voltage required at Kern River No. 3, with power factor practically zero leading, 42,000.

SPECIALLY DESIGNED GENERATORS FOR TWO VOLTAGES

From these conditions it will be noted that the generators at Kern River No. 3 are to be of a design not met with in ordinary practice. Full output in kva. is to be required at the normal voltage of 75,000, with 91

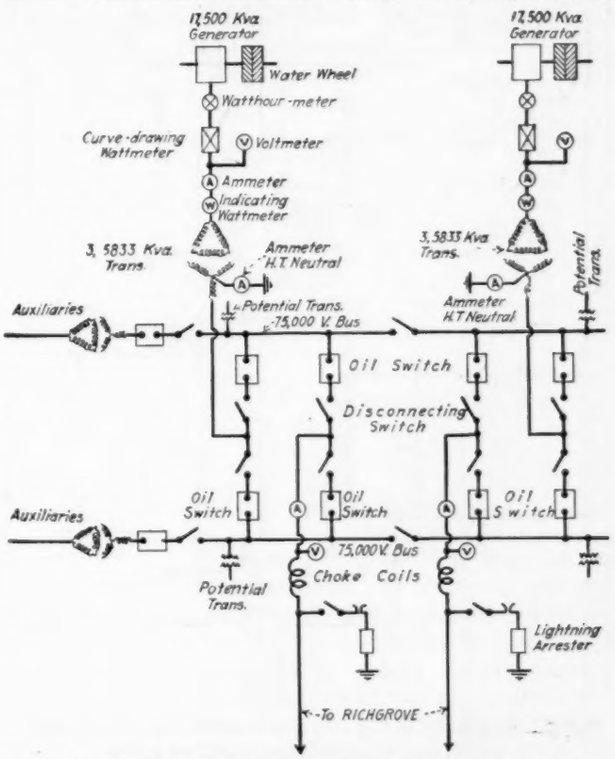


FIG. 2—KERN RIVER PLANT NO. 3 SHOWN SCHEMATICALLY
Arrangements made so that almost any proportion of capacity can be either 50 cycles or 60 cycles

per cent lagging power factor, and nearly full output in kva. at only 42,000 volts zero power factor leading. In order that the excitation system may be capable of controlling voltage within the limits desired, automatic voltage regulators are to be installed.

The generating units are to be of the vertical type with thrust bearings at the upper end of the shaft and three guide bearings, one above and two below the generator. The shaft is to be hollow so as to admit the handling of the turbine runner and to permit of easy interchange of the two sets of runners. One exciter is to be mounted on the upper end of each generator shaft, each to be of sufficient capacity to meet the requirements of one generator. An exciter driven by an induction motor which will be of sufficient capacity to meet the

requirements of two generators is to be used as an auxiliary.

The wiring scheme adopted was selected for the purpose of having the most simple connection from generators to line so as to remove the possibility of an operator switching a line or generator of one frequency onto one of the other frequency at times when one generator and line are operating at 50 cycles and the other at 60 cycles. The layout omits the usual low-tension buses and generator and transformer switches, and connection is made directly from the generators to their respective transformers. Even the energy for operation of the station lights and auxiliary power is to be taken from the high-tension buses by two three-phase, 400-kw., 75,000/2400-volt transformers. The leads from the generators are to be run to the transformers, which

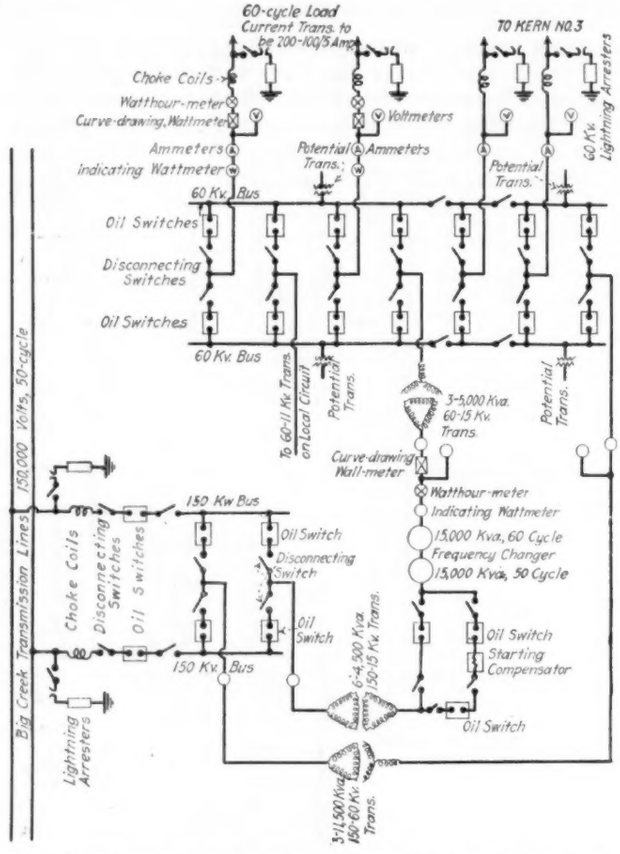


FIG. 3—RICHGROVE SUBSTATION, WHERE ENERGY IS DIVERTED TO EITHER TRANSMISSION LINE OR LOAD.

will be placed outdoors. From here connection is to be made to the high-tension buses and switches, which are to be installed indoors. Ample provision is made for indicating lamps and instruments so that the operators may be at all times informed as to existing conditions. Suitable protective devices are to be installed for the purpose of immediately disconnecting a generator and its transformers as a unit from the line, in case of electrical failure within the generator leads or low-tension windings of the transformers. Other apparatus is to be installed for the purpose of automatically disconnecting the defective line in case of a short circuit between Kern River No. 3 and Richgrove. The usual equipment of lightning arresters is to be installed on the outgoing lines.

The turbines, of Francis type, rated at 22,500 hp., will operate under a head of 800 ft. (243 m.) and will be the highest-head turbines ever built. The shaft is to be 14 in. (35 cm.) in diameter and, as with the generator shaft, is to be bored throughout to facilitate flexibility. In order that the runner and distributer may be removed as a unit when changing from one speed to another, the link mechanism for operating the gates is to be placed below the spiral casing. The wicket gates are to operate in a normally balanced state. A needle-type valve operated by water pressure under remote control is to be used for shutting off the water from the spiral casing, instead of the gate valve usually employed. To prevent undue rises in the penstock pressure, a governor relief valve is to be placed between this needle valve and the spiral casing and will open when the wicket gates close.

The guide bearing for the turbine will be of the oil-lubricated type, as it is expected that this type will be superior to the water-lubricated type for turbines running at the comparatively high speeds of these machines.

The water is to be carried from the forebay to the turbines through two pressure pipes constructed of riveted steel at the upper end and having an internal diameter of approximately 6 ft. (1.8 m.) and of welded steel at the lower end and an internal diameter of 5 ft. (1.5 m.). A conduit line consisting of 12 miles (19.3 km.) of tunnels will be driven through solid rock. There will be only ½ mile (0.8 km.) of flume and canal. The dam is for diversion only and no storage of water is intended. Forty per cent of the total mileage of tunnel has been driven to date.

TRANSMISSION LINE TO RICHMOND SUBSTATION

The transmission line is to be approximately 45 miles (72 km.) long and will consist of two circuits on a single steel-tower line. Suspension-type insulators are to be installed with five units in suspension construction and six units in dead-ends. An overhead ground wire is to be added for the purpose of providing protection against lightning.

THERE should be a group of nations that can furnish the things Europe needs to make an international loan to those countries, not of money. I would not put any money into those treasuries at the present time, but a loan of the credits that pay for the things that must be had to start the wheels of industry. I would send Europe machinery, equipment for the railroads, raw material; send it on time; have the payments secured by the very best security that they can give, and that means special security. I would make this comprehensive attempt to restart the industries, and I think we could do it, and I think Europe would start on toward a normal life. And along with that duty is the greatest opportunity that ever came to a people. We are the darling of the gods. No nation in all time was ever so placed, if civilization will really move on once more over there. Here we are, the reservoir of the world's capital, and at the same time the reservoir of raw material. We can finance the world and feed the world's industry with its raw material, and no nation was ever before so placed.—*Frank A. Vanderlip.*

Field Testing of Instrument Transformers—II

Experience with Differential Methods as Applied to Voltage and Current Transformers and to Acceptance Testing of Series Transformers for Street-Lighting Circuits—Possible Simplifications—Cautionary Measures Are Cited

BY H. M. CROTHERS
University of Wisconsin

METHODS of testing instrument transformers in which the secondary voltage or current of the transformer under test is opposed by the known secondary voltage or current of a standard transformer, and only the difference is measured, are classified as "differential methods." The advantage of such methods lies in the fact that the difference which is measured is 1 per cent or less of the total secondary voltage, so that errors of 2 per cent or 3 per cent in measuring the difference become errors of 0.03 per cent or less in the secondary voltage. Experience with several such methods is given with discussions of their advantages and limitations in field and laboratory work.

BROOKS' DIFFERENTIAL TEST FOR VOLTAGE TRANSFORMERS

In 1914 H. B. Brooks of the Bureau of Standards described a differential method of test for voltage transformers[1] which makes use of ordinary engineering instruments only, and therefore is available for testing in small meter shops or in the field. The scheme of connections is shown in Fig. 1.

Two transformers of the same nominal ratio have the common primary voltage E_p, which should be within a few per cent of rated primary voltage. The secondary windings are connected in series and to the potential coil of a wattmeter in such a manner that the voltages E_s and E_x (Fig. 1) oppose each other and the difference only is impressed on the wattmeter coil. The wattmeter current coil is excited through a control rheostat and an auxiliary transformer.

Fig. 2 shows the relation between the voltages E_p, E_s and E_x. The differences in value and in phase position between E_s and E_x are greatly exaggerated in the diagram. Line AC represents the voltage impressed on the wattmeter coil since it is the vector difference between E_x and E_s. The difference in absolute values is practically the voltage BC. This, then, is the difference which must be measured in order to compare the secondary voltages and the ratios of the transformers. When the wattmeter current is taken from lines 1, 2, in Fig. 1, it can be represented by a vector I along the dotted line OX. The reading in watts is equal to I multiplied by the component of the voltage AC which is in phase with I, or by BC. Voltage BC may be determined then from the equation $BC = \frac{P}{I}$ in which P equals wattmeter reading, I = ammeter reading.

Dividing the voltage BC by E_s, which may be measured with a voltmeter, gives the *percentage* difference in the secondary voltages, which is equal numerically to the percentage difference in their ratios, since the primary voltage is the same for both. This is also the same as the percentage difference in the "ratio factors" which are defined by the equation "Ratio factor (stated in per cent) = 100 × true ratio ÷ marked ratio," and are represented by the symbols F_s (for the standard transformer) and F_x (for the transformer under test).

The result written as an equation becomes:

$$F_x = F_s \pm \frac{100\,P}{E_s\,I}. \qquad (1)$$

For the purpose of determining the proper sign of the last term recall that a lower secondary voltage means a higher ratio or a higher ratio factor, and that adding non-inductive load to the secondary decreases the secondary voltage. This leads to a rule: Connect additional non-inductive load (incandescent lamps) to the test transformer secondary and if the reading of the wattmeter increases use the + sign in equation (1). If the reading decreases use the — sign.

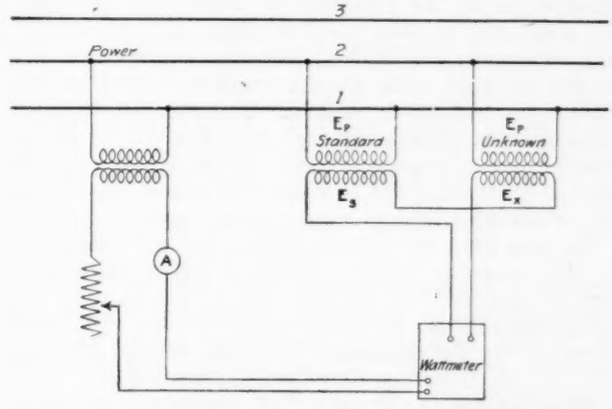


FIG. 1—BROOKS METHOD FOR TESTING VOLTAGE TRANSFORMERS

This method of determining the ratio of voltage transformers has been found very satisfactory. It is simple, quick, and sufficiently accurate for any commercial test. It is especially valuable because results are not affected by ordinary line voltage fluctuations.

Sometimes the knowledge of the ratio is all that is desired. This is the case except when wattmeters or watt-hour-meters operating at low power factor are connected through the transformer. Then a knowledge of the phase shift in the secondary voltage is also necessary.

DETERMINATION OF PHASE ANGLE

The phase angle of a voltage transformer is defined as the angle by which the secondary voltage leads the primary voltage reversed. In Fig. 2, β_x is shown as a negative angle. Angle AOB is always the algebraic difference between β_s and β_x. AOB in radians = $\frac{AB}{E_s}$ or angle AOB in minutes = $3438\,\frac{AB}{E_s}$.

$$3438\,\frac{AB}{E_s} = \pm\,(\beta_s - \beta_x), \qquad (2)$$

from which β_x may be found when voltage AB is known.

For measuring the voltage AB the instructions given

[1] *Bulletin*, Bureau of Standards, Vol. 10, p. 419.

in the original Bureau of Standards article were substantially as follows:

Balance the ratios by adding non-inductive load to one or the other of the transformers. Then, taking current for the wattmeter coil from the adjacent phase of a two-phase or a three-phase supply, calculate the value of AB from

$$AB = \frac{P \text{ (watts)}}{I \text{ (wattmeter current)}} \qquad (3)$$

if a two-phase supply is used, or

$$AB = \frac{P}{I} \cos 30^\circ = 1.16 \frac{P}{I}, \qquad (4)$$

if a three-phase supply is used.

To settle the question of which secondary voltage is ahead in phase position, the following rule is usually given: Add non-inductive load to the secondary of the transformer under test. If the wattmeter reading increases, the voltage E_s leads E_x. If the wattmeter reading decreases, E_x leads E_s.

The above rule is sufficient if a two-phase supply is used. With three-phase supply, however, the rule may give the wrong result for the following reason: Adding non-inductive load changes the ratio as well as the phase-angle of the transformer under test and, since the wattmeter current is out of phase with the secondary voltages by only 60 deg., any change in the ratio and in the absolute value of the secondary voltages also affects the wattmeter reading. The characteristics of voltage transformers are such that the change in the reading due to change in ratio may be larger than the change in reading due to change in phase angle. The rule above may lead to error in that case.

To take care of this possibility, the rule should be modified to read: Add non-inductive load to the secondary of the test transformer *and again measure the difference between the phase angles of the two transformers.* If the difference increases, voltage E_s leads E_x. If the difference decreases, E_x leads E_s.

Experience with the method of measuring the voltage AB as outlined above soon led to difficulty which is illustrated by one extreme case. In order to balance the ratios as called for, it was necessary to load the transformer under test to over twice its rated capacity. In other words, it was impossible to measure the phase angle at anything less than twice rated load. Instances of such difficulty led to the search for other procedures which might be substituted. Two changes were tried, either one of which may be of service in helping others meet similar difficulties.

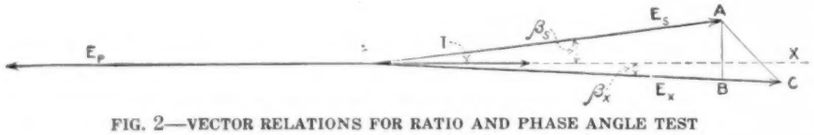


FIG. 2—VECTOR RELATIONS FOR RATIO AND PHASE ANGLE TEST

SECOND PROCEDURE FOR MEASURING PHASE ANGLE.

Since the difficulty arose in balancing the ratios, the idea of balancing was abandoned. The loads were left at the points at which it was desired to compare the transformers, and after measuring voltage BC to determine ratio, the voltage taps were shifted as before.

If a three-phase supply is used, as is usually the case, the wattmeter current is shifted practically 60 deg. from the voltage E_s. The voltage and current relations in the wattmeter are shown in Fig. 3. Voltage AC and the two components AB and BC are shown as they were in Fig. 2. Line AX represents OX in Fig. 2 and the vectors I show the possible positions of the wattmeter current.

Since the component BC is already known, the reading on the wattmeter due to it may be calculated as $BC.I \times \cos 60^\circ$ or $\frac{BC.I}{2}$. The part of the reading on the wattmeter due to the voltage AB therefore is $P \pm \frac{BC.I}{2}$. To settle the uncertainty in sign, a definite order of operations must be laid down and followed carefully.

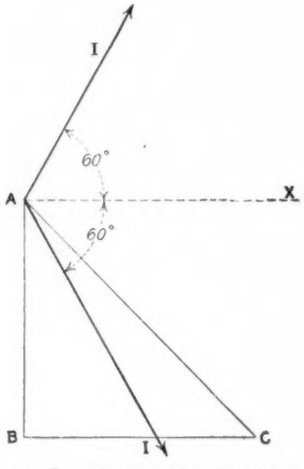


FIG. 3—FINDING PHASE ANGLE BY ALTERNATIVE METHODS

The order chosen is as follows: Take the wattmeter current from the lines 1.2, Fig. 1, and adjust the wattmeter connections until the reading is positive. Then, leaving one of the current supply wires fixed, shift the other to line 3 and take the reading to determine phase angle. If the wattmeter reading is positive without reversing wattmeter connections, the voltage AB is given by the equation

$$AB = \frac{P - \frac{1}{2} BC \times I}{I_1 \times \cos 30^\circ} = 1.16 \left(\frac{P}{I} - \frac{BC}{2} \right) \qquad (5)$$

If the connections to the wattmeter must be reversed connections, the voltage AB is given by the equation

$$AB = 1.16 \left(\frac{P}{I} + \frac{BC}{2} \right) \qquad (6)$$

This gives the value of AB, and the question of which is the leading vector is settled by the general rule given above.

This procedure overcomes the difficulty encountered with the original method. The advantage of this second method is that the phase angle may be measured with any desired condition of loading on the secondary of either transformer. The disadvantages come from the facts that the order of operations and formulas to be used require more to be kept in mind than the original plan, and that an error is introduced if an unbalanced three-phase system is used. This makes the angle by which the wattmeter current is shifted something more or less than 60 deg., and formulas (4) and (5) are based on a shift of 60 deg.

THIRD PROCEDURE FOR MEASURING PHASE ANGLE.

The disadvantages of the preceding method disappear if the wattmeter current is shifted exactly 90 deg. from E_s. Then the effect of the component BC, Fig. 3, on the wattmeter reading is zero. The equations (4) and (5) become

$$AB = \frac{P}{I}. \qquad (3)$$

To obtain a current shifted by 90 deg. the connections shown in Fig. 4 are used for three-phase circuits. The wattmeter current is supplied through two rheostats

connected across different phases of the supply circuit. With the connections exactly as shown it is possible by varying the currents through both rheostats to give the total wattmeter current any desired shift between 60 deg. and 120 deg. The rheostats are easily adjusted to bring the reading of the auxiliary wattmeter to zero, thus showing that the desired angle of 90 deg. between I and E_s has been obtained. Then the readings of the ammeter and the original wattmeter are taken and equation (3) applied to determine AB.

Other methods of obtaining a current shifted by 90 deg.

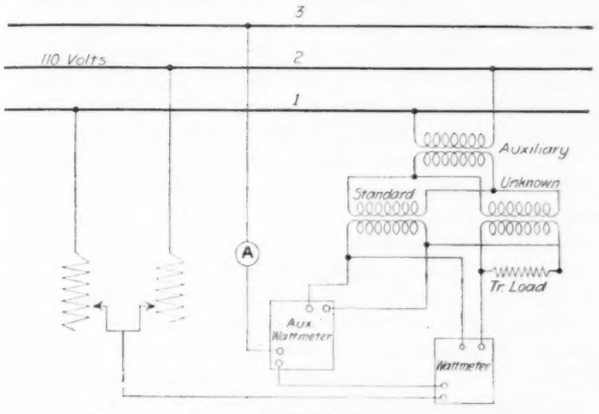


FIG. 4—ALTERNATIVE METHOD FOR DETERMINATION OF PHASE ANGLE

from phase 1, 2, are possible and might be more convenient in some laboratories.

Choice of the procedure to be used in measuring phase angles depends upon convenience alone, except when the balancing of ratios, as originally called for, is impossible. The standards laboratory of the University of Wisconsin has adopted the last procedure exclusively. A small board provided with labeled switches and terminals makes the matter of setting up the circuits very simple, and tests are completed in a few minutes. In shops in which such tests are not frequently called for, one of the first two methods might be preferred, since less equipment is needed and connections are somewhat easier.

The wattmeter used to measure the differential voltages should have a low voltage scale. Meters with large overload current capacity are especially good since the reading can be brought farther up scale by using the maximum allowable current. A special voltmeter designed especially for conducting this test is also on the market.

DIFFERENTIAL TEST FOR CURRENT TRANSFORMERS.

In the ELECTRICAL WORLD for Oct. 6, 1917, F. B. Silsbee described a differential test applied to current transformers. The writer has had no experience with the scheme exactly as described therein, but, in connection with F. A. Kartak of the standards laboratory, University of Wisconsin, he applied in June and July, 1917, practically the same scheme to series transformers for street-lighting circuits. It was necessary to develop a method for use in acceptance tests at the factory to determine whether the ratios came within prescribed limits and no other available method combined the necessary speed and accuracy. Fig. 5 shows the scheme of connections. A standard transformer carefully built and calibrated delivers its secondary current through the wattmeter current coil. The secondary current of the transformer under test is passed through the same coil, but in phase opposition to the other. The resulting wattmeter current is the difference between the two and the method of measuring it is similar to that for voltage transformers.

The wattmeter voltage coil is excited from voltage taps across the resistance R in the primary circuit. R is so adjusted that with 6.6 amp. flowing the voltage across the wattmeter is such as to make the wattmeter scale direct-reading in current, one small division corresponding to 10 milliamperes.

A switchboard was made with artificial load for the transformers and mercury cups for connecting. By means of this ratios could be determined at three loads and within 0.1 per cent at the rate of 100 to 150 transformers per hour. The results given by this method were checked within 0.1 per cent by more careful laboratory tests.

In the work described above use was made of the 37.5-volt tap and the 2½-amp. range of a wattmeter on which full-scale deflection corresponded to 18.75 watts. It is seen to be sufficiently sensitive when comparing secondary currents of the order of 6.6 amp., but in testing current transformers in which tests would be required at ½ amp. or less, secondary current, this instrument would not be sufficiently sensitive. The method has been used satisfactorily with a wattmeter similar to the one above, but with current rating and watts required for full-scale deflection reduced to one-fifth of the value above. This gives satisfactory results down to ½ amp. secondary current, but such wattmeters are not always available.

DIFFERENCE BETWEEN SILSBEE'S SCHEME AND THE ON DESCRIBED

Silsbee's scheme of connections differs from the scheme above in that the current coil of the wattmeter is separately excited and the unbalanced current is passed through the voltage coil. He points out two things to be guarded against: (1) the counter-emf. due to the high resistance of the voltage coil, and (2) the emf. set up by mutual inductance from the current coil. The first danger is relieved by connecting

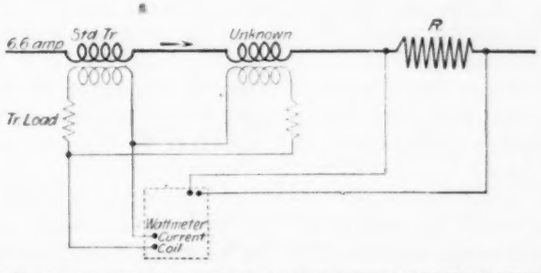


FIG. 5—DIFFERENTIAL METHOD FOR TESTING SERIES LIGHTING TRANSFORMERS

directly to the terminals of the moving element in the meter. The second danger is relieved by setting the axis of the moving coil at right angles to the axes of the fixed coil. The advantage of this scheme lies in the fact that any wattmeter may be used. The disadvantage lies in the special adjustment and connections which should be made inside the meter.

Either scheme of connections offers a method for the field testing of instrument transformers which will be found to be quick, fairly accurate, and independent of line voltage fluctuations.

Spain Plans National Transmission Network

To Connect All Industrial Centers with Power Plants at Larger Waterfalls and Coal Mines, Thereby Avoiding Trouble from Droughts and Coal Shortage—Over 2,000,000 Hp. in Water Power Awaits Development

BY GEORGE F. PAUL

THE construction of a national network of high-tension transmission lines linking all industrial centers of Spain with the larger waterfalls and coal mines has recently been proposed and will in all probability go into effect eventually because of the droughts and coal shortage that now hinder economical development of power. It has long been evident that there would be many distinct advantages to all concerned if a national system, comprehensive in its nature and thoroughly modern as regards equipment, should be developed. What such a system would mean to the industrial and commercial future of Spain cannot be estimated, but it is known that the effect will be distinctly beneficial.

The system as planned by the special commission which has this development under advisement would consist of a number of transmission lines passing through or near all of the leading commercial centers. Most of these important centers thus to be supplied with power are on the north and east coasts. The larger waterfalls, of which there are many, would be used to generate power, and they would be supplemented by the coal mines. Spain has several large coal fields where the grade of coal produced is so low that it cannot be handled commercially to advantage, but in a nation-wide plan like this these low-grade coals could be burned in plants at the mines, thus producing electrical power at the seasons of drought which are of annual occurrence in all parts of Spain and make it impossible to place entire dependence on hydroelectric power. In the central part of the peninsula the water supply is greatly reduced from five to six months of the year, a period that usually begins about the second week of June. In the zone to the northwest, lying south of the Bay of Biscay, this season is reduced to three months, commencing generally about the first week in July. In the zone to the northeast, lying to the south of the Pyrenees, there are two periods of low water, one in September and October and the other in January and February.

In preparing a list of places where hydroelectric power could be generated, the commission listed only the waterfalls capable of producing more than 2000 hp. The results are given in the accompanying table.

It is very apparent that one of the most decided advantages to be derived from such a national network, aside from the continuous supply of cheap power to all consumers, whether large or small, is the unification of the frequency and voltage. The frequency is now standardized throughout Spain at three-phase, 50 cycles, and the voltage would be regulated after a careful study had been made of the amount of power needed by the leading industries of the country. The commission makes the recommendation that for the main branches of the transmission line the potential should be not less than 120,000 volts.

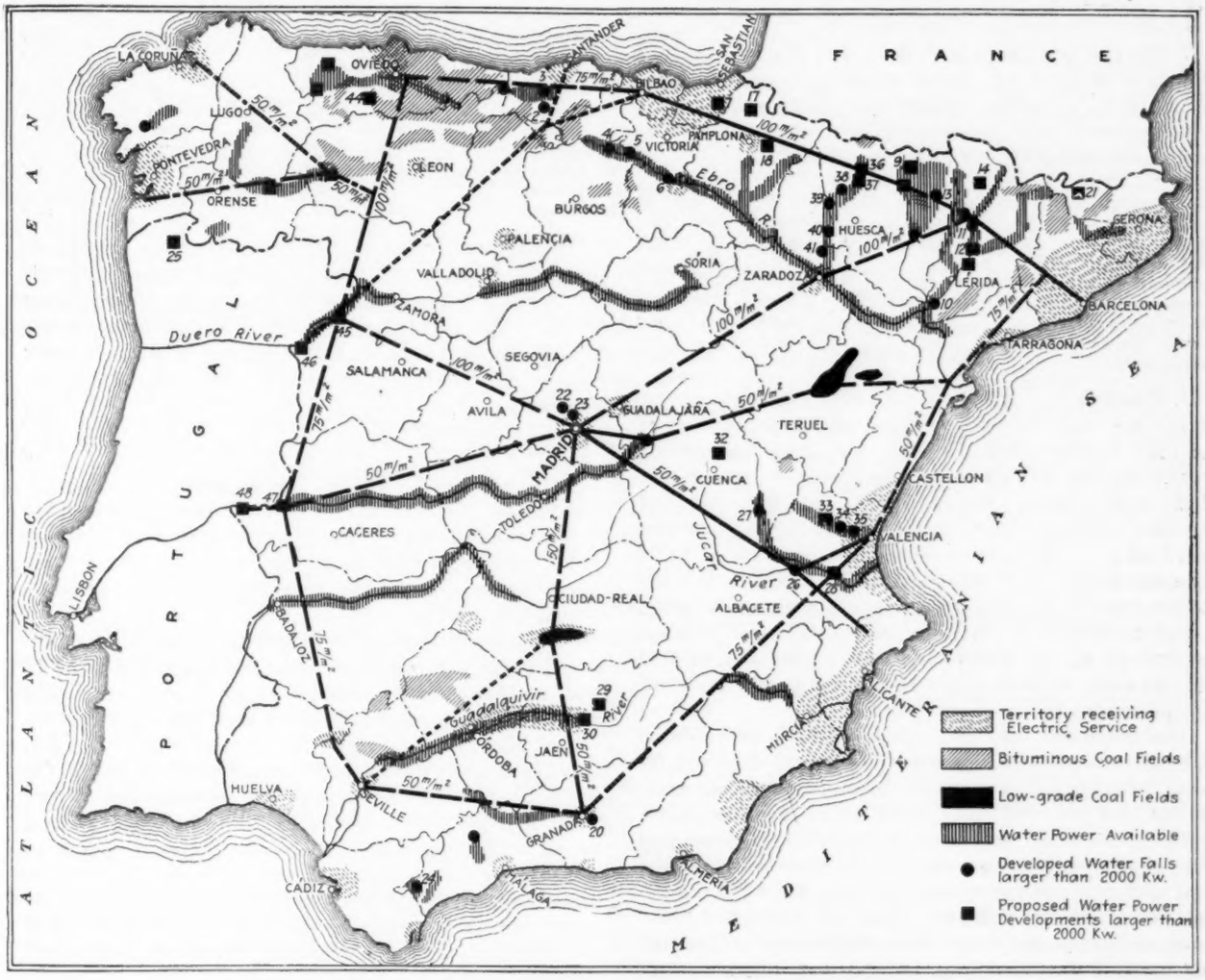
Detailed studies have been made in order to determine the cost of this vast system of lines. The figures are based on the assumption that there will be 888 miles (1420 km.) with wires having a sectional area of 50 sq.mm. and 1100 miles (1760 km.) with wire of 100 sq.mm. area. The lines would be duplicate throughout, protected by a ground wire and provided with four telephone circuits. The supports, according to the practice of the three largest plants now operating in Spain, may be of concrete and steel spaced at an average distance of 410 ft. (123 m.). The insulators considered proper are those of the suspension type, six elements in series. Proceeding in this manner and taking a line with 100-mm. wire, the prospective cost per kilometer is divided as follows: eight steel towers of 800 kg., at 1 peseta (19.3 cents) per kilo, erected, 6400 pesetas ($1,235), including the foundation; forty-eight strings of insulators at 75 pesetas ($14.48), or 3600 pesetas ($695); 1000 m. of grounding cable 10 mm. in diameter and weighing 500 grams per meter, in place, 1000 pesetas ($193); six conductors of 100 sq. mm. weighing 5400 kg., at 2 pesetas (38.6 cents), or 10,800 pesetas ($2,084); with loss of 5 per cent of curves, joints, etc., 540 pesetas ($104); protection and switching stations, 2500 pesetas ($482); telephone line, 850 pesetos ($164). Adding these amounts, the total per kilometer is found to be 25,690 pesetas ($4,958), to which must be added certain other expenditures, bringing the cost up to 30,000 pesetas ($5,790). From this figure the costs of the lines with 75-mm. and 50-mm. wires are deduced, the former being 27,300 pesetas ($5,269) and the latter 24,600 pesetas ($4,748). Multiplying these costs by the respective number of kilometers to be built, the total is 119,202,000 pesetas ($25,090,000) for the entire network completed and ready for operation.

SPANISH WATERFALLS WITH HYDROELECTRIC POSSIBILITIES

	Hp.
Atlantic slope of Leon and Galicia	70,000
Asturias	40,000
Santander	30,000
Ebro, before reaching Zaragoza	65,000
Rivers from the slopes of the Pyrennes	490,000
Ebro, from Zaragoza to the ocean	130,000
Duero, in Spain	90,000
Duero, on the Portuguese frontier	150,000
Tributaries of the Duero	50,000
Tajo	110,000
Tributaries of the Tajo	50,000
Guadiana	35,000
Guadalquivir and other Andalusian rivers	40,000
Jucar and Cabriel	90,000
Other rivers on Mediterranean slope	60,000
Falls of minor importance	500,000
Total	2,000,000

The commission goes into considerable detail in regard to the principal bases upon which a proposed law might be drawn up. It recommends that the enterprises which utilize this system of power distribution shall pay an annual fee representing the cost to the state in interest for obtaining the necessary capital, plus the

cost of the care and the maintenance of the system, and such enterprises shall comply strictly with the regulative instructions issued by the Minister of Public Works, who shall also be able in each zone to establish the prices for the purchase and sale of power in that part affecting the national system. The lines of this general system may be utilized by consumers who require the total capacity of a line; also by enterprises which do not utilize the full capacity of the line and which



ELECTRICAL DEVELOPMENTS AND PROJECTED DEVELOPMENTS IN SPAIN

desire to furnish or take, or both, power of the national system, and in this case the state shall fix the prices of production and consumption, the difference representing the quantity which it is to collect as rental.

Enterprises desiring to come under this law must apply to the Ministry of Public Works, setting forth the condition of their installations and agreeing to conform to the general regulations. The state will require that the system must utilize chiefly electric power of fluvial origin, which may be created by establishing dams in the rivers. Enterprises which through insufficient means for assuring reliable and continuous service shall cause loss to the consuming industry will be obliged to provide themselves with the necessary means for assuring such service, or must join the national system in order to remedy the defect. The state may accept within its systems power from private individuals who may place this power at its disposal. The general design of the system to be adopted will be intrusted to a commission of experts experienced in hydroelectric problems and in the transmission of high power at long distances. This commission will make a study of the utilization of fuel of an inferior quality and low price, or coal which is found in regions incapable of being exploited owing to distance from consuming centers.

Any industrial operator may utilize the system for the marketing of power proceeding from hydroelectric or steam plants, delivering the power in a three-phase current, 50 cycles and 120,000 volts, or whatever pressure may be stipulated by the commission of experts. Any enterprise which takes advantage of this distributing system has to accept the conditions which the Ministry of Public Works may impose for the discontinuation of the service. This technical body will write the articles of the law and the regulations, and the law, prepared on this basis, will be passed to the Cortes. In addition, it is to study within the shortest possible time the project for the unification of voltages, both for the energy which is to be conducted by its own lines and for the distribution thereof to the consumers; these conditions shall be obligatory for all new installations, whether they utilize the services of the system or not.*

*Title of official publication: "Proyecto de Ley para el Establicimiento de Una Red Nacional de Distrubucion de Corriente Electrica." Ministerio de Fomento, Madrid, Spain, 1919.

ELECTRIC LIGHT AND POWER STATIONS OF NEW YORK STATE

An Interpretation of Items of Income, Operating Expenses, Primary Power and Output as Contained in the Census Report

BY SIDNEY GRAVES KOON, M.M.E.

THE figures of the census report at page 540 of the ELECTRICAL WORLD for March 15, 1919, lend themselves to an interesting analysis.

I. The Unit or Average Plant.—The figures for 1912 showed a total of 321 "establishments," increasing to 332 in 1917. Dividing the principal items in the report by these two figures successively, the results arrived at for the average plant are:

	1912	1917	Per Cent Increase
Total income	$178,252	$255,170	43.2
Electric service	165,698	240,456	45.2
Total expenses	138,000	202,565	46.8
Salaries and wages	34,377	46,132	34.2
Persons employed	43	49	14.0
Primary horsepower	3,607	5,281	46.4
Kilowatt capacity	2,405	3,650	51.7
Output, kw.-hr.	6,775,851	11,531,904	70.2

II. The Financial Changes.—In 1912 the electric service income ($53,189,000) represented 92.96 per cent of the total income ($57,218,973). In 1917 the electric service income ($79,831,241) represented 94.23 per cent of the total income ($84,716,578). This left only 5.77 per cent for "all other income" in 1917, as compared with 7.04 per cent in 1912—a relative decrease of 18.04 per cent, though "all other income" showed a healthy enough growth of 21.2 per cent in the five-year interval. It will come as a surprise to many who have watched the growth of the electric accessory business to find that the sales of these items by the companies have not kept pace with their sales of energy.

Total expenses in 1912 ($44,297,869) represented 77.4 per cent of total income. The report does not indicate whether taxes were included in total expenses, but the 77.4 per cent leads to the belief that they were. In 1917 the total expenses ($67,251,033) represented 79.4 per cent of total income—an increase which would have been anticipated by any one familiar with the operations of the companies. But the next deduction would certainly not have been anticipated—that the amount paid for salaries and wages was a smaller proportion in 1917 than in 1912, both of total expenses and of total income:

	1912	1917	Per Cent Increase
Salaries and wages	$11,034,898	$15,315,788	38.8
Per cent or total expenses	24.9	22.75	—8.63
Per cent of total income	19.3	18.1	—6.25

The average annual remuneration per person employed increased 17.4 per cent, from $803 in 1912 to $943 in 1917. This percentage increase was not enough, however, combined with the increase in number of persons employed, to bring the total salaries and wages up to the proportionate figure for 1912, as compared with total expenses or income.

The income from electric service divided by kilowatt-hours shows an average of 2.45 cents per kilowatt-hour in 1912 and 2.09 cents in 1917. This decrease of 14.7 per cent is about what current practice and regulation would lead one to expect.

III. Primary Power.—The census report gives the number of prime movers and the total horsepower (rating) of each type. A study of the change in average size shows some surprising figures for growth, when the brief interval of five years is considered. The steam engine has more than doubled in average size:

	1912	1917	Per Cent Increase
Steam engines:			
Number	553	488	—11.8
Horsepower	638,932	105,345	64.7
Average	1,155	2,361	104.4
Gas and oil engines:			
Number	66	70	6.0
Horsepower	6,471	5,948	—8.1
Average	98	85	—13.3
Waterwheels:			
Number	405	421	4.0
Horsepower	512,406	694,898	35.6
Average	1,265	1,651	30.5
Total prime movers:			
Number	1,024	979	—4.4
Horsepower	1,157,809	1,753,191	51.4
Average	1,131	1,791	58.4

Despite the slogan of "conservation," as applied to coal and fuel oil, the power derived from hydraulic plants did not keep pace with the growth of the steam plants. The percentages of the total primary power covered by each type of prime mover were as follows:

	1912	1917
Steam engines	55.1	60.1
Internal-combustion engines	0.6	0.3
Waterwheels	44.3	39.6

From four-ninths in 1912 the waterwheels fell below four-tenths of the total in 1917. The steam engine group includes, of course, steam turbines, in which most of the gain of the group has been made—if, indeed, the reciprocating engines have not shown an absolute decrease.

The average capacity in kilowatts of generators connected to each prime mover has increased from 754 in 1912 to 1238 in 1917, a gain of 64.19 per cent. The total capacity in kilowatts per person employed has increased 32.6 per cent, from 56.2 kw. in 1912 to 74.5 kw. in 1917. This is due in large measure, of course, to the sharp increase (15.4 per cent) in average capacity of prime movers. It is probable that the more general use of automatic stokers was also a large factor in keeping down the number of employees.

The kilowatt capacity of dynamos per horsepower of prime movers increased from 0.668 in 1912 to 0.692 in 1917, indicating a slightly improved mechanical efficiency.

IV. Output.—The over-all load factor, based on 8760 hours per year in 1917 and 8784 in 1912 (leap year), showed 32 per cent in 1912, advancing to 36 per cent in 1917—a fine result of the constant effort to get "off-peak" business. This was doubtless one of the heavy contributory causes to the reduction in average price per kilowatt-hour.

The output per person employed increased 48.7 per cent, from 158,300 kw.-hr. in 1912 to 235,500 kw.-hr. in 1917. Growth in sizes of prime movers is shown by the increase of 84.1 per cent in average output per prime mover—from 2,124,071 kw.-hr. in 1912 to 3,910,717 kw.-hr. in 1917.

Motors connected decreased 24.7 per cent in number, but increased 50 per cent in rated capacity of connected load. This was based on an increase of 99 per cent in average size of motor, from 9.65 hp. in 1912 to 19.2 hp. in 1917.

No appreciable change has apparently taken place in the proportion of motors to the total connected load.

Operating Records of Electric Steel Furnaces

Characteristics, 1918 Energy Consumption, Maximum Demand and Steel Output of Eighteen Arc-Type Furnaces in Milwaukee District, with the Experience of Some of the Users in Operating Them

TEN three-phase, two two-phase and six single-phase arc-type steel furnaces in the Milwaukee industrial district poured over 40,000 tons (36,300 t.) of electric steel and consumed nearly 30,000,000 kw.-hr. during the year 1918. The rating of the individual furnaces ranges from 1 ton (900 kg.) to 12 tons (10.9 t.) of steel per heat, and the total rated output of the eighteen furnaces is 57.5 tons (52 t.) Of this the six single-phase furnaces pour 8.5 tons (7.7 t.) per heat, the two two-phase furnaces four tons (3.6 t.) per heat, and the ten three-phase furnaces 45 tons (41. t.) per heat. A detailed operating record of each furnace is given with this article in tabulated form. The general characteristics of the five different types of furnaces represented are as follows:

Pittsburgh.—The Pittsburgh furnace (Moore patents) is a three-phase, four-wire furnace with three vertical equilaterally spaced electrodes entering the furnace through the roof. The neutral is connected to the bottom of the furnace to help in melting down a charge, as it permits an arc to be struck from one electrode to the metal without waiting for another electrode to make contact. This connection also distributes any unbalance between phases. The largest of these furnaces is rated at 12 tons (11 t.) but has actually poured many 17-ton (15.4-t.) gun ingots for the United States government. This is said to be the first furnace in which switches are provided for reducing the arc voltage required for melting to half that value for refining while the furnace is in operation. The transformers are built for six adjustments of voltage. Eight of the furnaces listed in the tabulation are of this type and they are rated to pour a total of 39 tons (35.4 t.) of steel per heat.

Snyder.—Milwaukee has six Snyder single-phase furnaces with a rating of about 8½ tons (7.7 t.) of steel per melt. In these units there is one vertical electrode through the center of the roof and the other lead is connected to a water-cooled steel electrode projecting through bottom of the furnace. The potential across the transformer secondary is usually 220 volts, but this is reduced by reactance to about 140 volts across the arc when melting.

Heroult.—This furnace, of which there are two 3-ton units in the district under consideration, is a three-phase furnace with three vertical electrodes through the roof. Neither neutral connection nor the double-voltage switch is used with these furnaces, and the phase potential at the arc is about 90 to 100 volts across the delta.

Rennerfelt and Von Baur.—The Milwaukee company has one 1-ton (900-kg.) Rennerfelt furnace and one 3-ton (2700-kg.) Von Baur furnace on its lines. These furnaces are both designed for two-phase operation, T-connected transformers being generally used where only three-phase service is available. The phase potential across the arc is about 100 volts from electrode to bath for the Rennerfelt and 105/120 volts for the Von Baur furnace. Both furnaces make use of three electrodes to carry the two-phase energy into the furnace. There is one large electrode to which the common lead of the two-phase service is connected, and the other two leads are connected to smaller electrodes in both furnaces. In the Rennerfelt furnace the two small electrodes enter horizontally through diametrically opposite openings in the furnace walls and the large electrode enters vertically through the center of the roof. The Von Baur furnace, however, uses three vertical electrodes, which enter the furnace through the roof. These electrodes are in a straight line, and the large electrode is placed between the two small ones.

The electrodes in the Snyder, Rennerfelt and Von Baur furnaces are regulated by hand, while in the Moore and Heroult furnaces automatic control is used. In the latter case automatic current regulators operate direct-current motors which drive the electrode winches. As direct-current service is rarely available in the vicinity of the furnace, a small motor-generator set is usually installed for that purpose. The electrode winches of a 3-ton, three-phase furnace are usually driven by special oilless-bearing inclosed motors and a small motor-generator set is installed to drive the three winch motors.

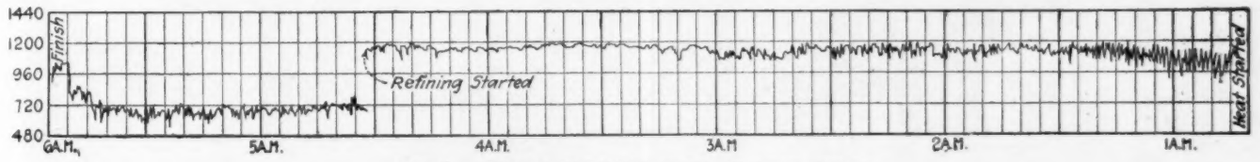


FIG 1—TYPICAL ELECTRIC FURNACE LOAD CURVE

Heat run on tool steel, heavy basic refining, showing that, with the requisite amount of reactance, electric steel furnaces make a very desirable central-station load. The increased power input at the end of the refining period is to superheat the steel before pouring. The curve was taken on a 6-ton furnace supplied from transformers rated at 1200 kva. The heat is of long duration in this case because of the special nature of the steel being made. The same transformers connected to some types of 3-ton acid foundry furnace would turn out a heat in about one and one-half hours.

The power company requires the installation of an ammeter for each electrode, a voltmeter which can be plugged across each phase and one integrating wattmeter to register the kilowatt-hour input to the furnace transformer during each heat. According to Milwaukee experience, these meters are necessary for the efficient operation of the furnace. In some cases an indicating or curve-drawing wattmeter is also installed to show the operator when the maximum demand is going too high. The melter must keep the maximum demand within the safe rating of the transformers.

One hundred and seventy kva. per rated ton was considered ample some years ago for 3-ton furnaces, but the operators have found it more economical to melt steel faster until now 500 kva. per ton is used with some furnaces of this size. Large transformers make it possible to melt down quickly, and a quick heat means reduced heat losses, a lower energy consumption per ton and increased steel output. When the charge does not require refining an electric arc furnace can pour twelve heats in a day of twenty-four hours, and if such a furnace is not limited by the transformer rating 1000 tons of steel can be melted per month with a 3-ton furnace. Sometimes rush orders make it necessary to take all the power the transformers will give for only a few heats or a few days a month. From the standpoint of

cost of power alone, however, it is not good practice to force a furnace to its maximum capacity unless there is sufficient work to maintain this rate of production for a protracted period. It usually takes more than a few days' saving in kilowatt-hours per ton due to the rapid operation to offset the increased expense for the higher maximum demand required. Under normal conditions it is considered best to keep the monthly maximum demand down to the lowest possible figures for any given steel output, which means operating at a high load factor. The load factors, energy consumptions and maximum demands given in the table are over-all figures which include the use of furnaces, lighting and the power used in the plant. Segregated figures were not available. However, the sizes of the transformers installed for the furnaces are shown separately from those supplying the light and power requirements in each case.

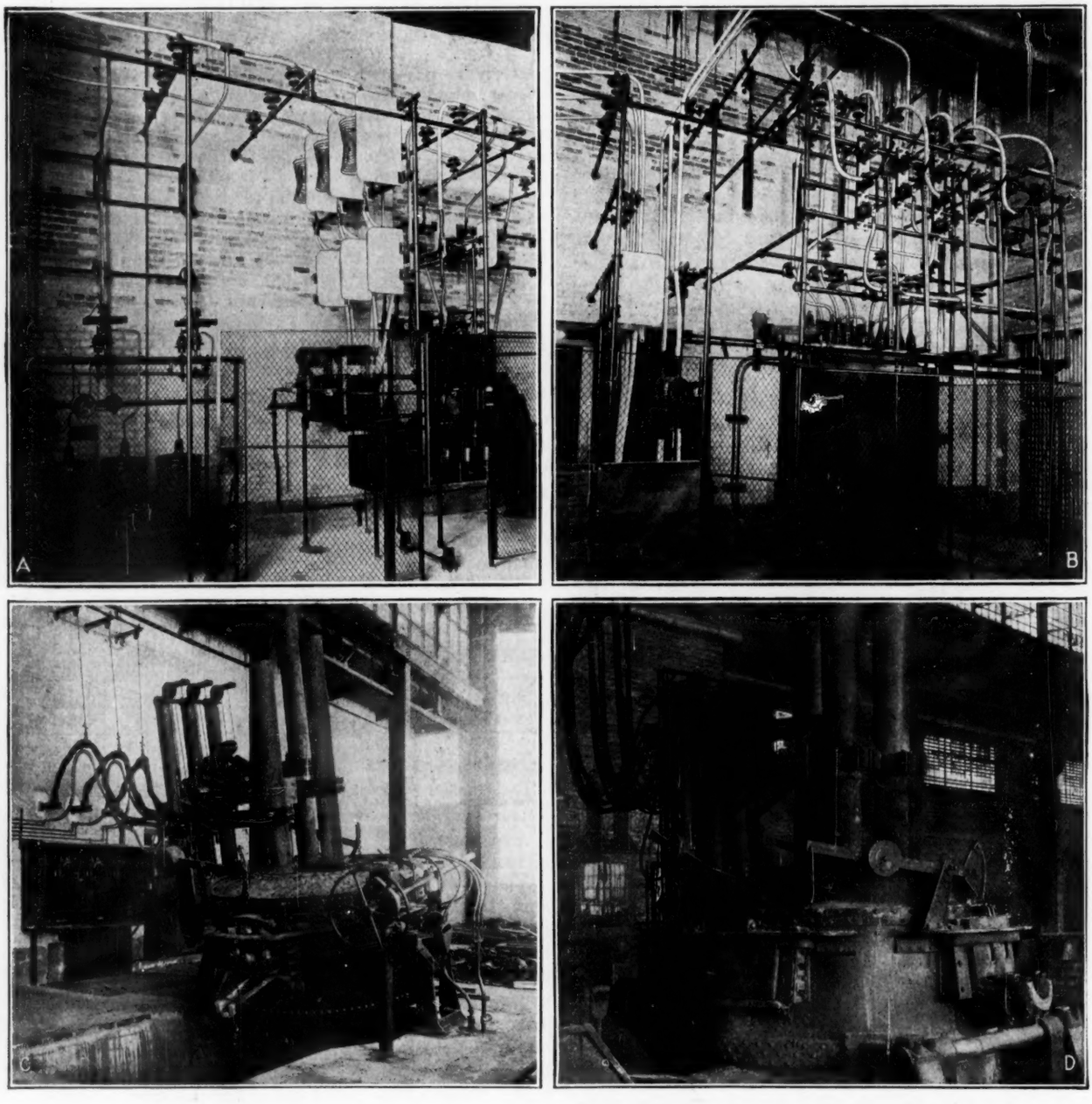


FIG. 2—INSTALLATIONS OF THREE-PHASE ARC-TYPE STEEL FURNACES AND EQUIPMENT SERVING THEM

A—View of 13,200-volt industrial substation showing choke coils, electrolytic lightning arresters, automatic oil switch and primary metering equipment for measuring all service used in foundry, including a 3-ton electric steel furnace. B—Another view of the substation illustrated in "A," showing three-phase, 1000-kva., 13,250/55-110-volt furnace transformer and double-throw air-break switches for supplying 55 volts or 110 volts (from phase to neutral) to the furnace. The full secondary voltage is used during the melting-down period and the half voltage is used for refining. C—Pouring side of 3-ton "Pittsburgh" acid foundry furnace. The electrodes are controlled automatically by the Westinghouse regulators mounted in a box on the wall to the left of the furnace. The furnace meters, etc., are on a panel to the right of the regulators. The secondary leads to the furnace are balanced by counterweights in the substation (*A* and *B*), which is on the other side of the wall. The steel wires connecting the leads to the counterweights go through the wall at the top left-hand corner. D—Heroult 3-ton basic furnace installed in 1916 and fed through the three groups of secondary leads shown in the top left-hand corner of the picture. Part of the case containing the automatic electrode regulators is visible on the left side.

No power-factor values are given in the tabulation, but this is an important operating characteristic for central stations to consider in each furnace installation. The power factor may range from 40 to 60 per cent in the single-phase furnaces to about 90 per

OPERATING DATA OF EIGHTEEN ELECTRIC ARC-TYPE STEEL FURNACES IN MILWAUKEE

Plant	Furnaces Installed: Number	Year	Rating Tons per Heat	Type	Basic or Acid Lining: Possible Lining	Basic or Acid Lining: Lining Used During 1918	Phases	Volts at Arc	Transformers Kva.: Furnace Transformers, Kva.	Transformers Kva.: Light and Power Transformers, Kva.	1918 Records *: Monthly Kw. Demand Primary High	Monthly Kw. Demand Primary Low	Total Primary Kw.-Hr.	Tons Melted	Primary Kw.-Hr. per Ton	Operating Period: Mos.	Operating Period: Hours per Day	Equipment Replaced by Electric Furnaces	Per Cent Load Factor, 1918	Per Cent Load Factor, 1917	Furnace Product
Foundry A	1	1914	1.5	Snyder	Acid	Acid	1	140	700	115	592	444	1,270,000	2,000	635	12	10	Crucible	24.5	26.6	Steel castings
	1	1915	1.5	Snyder	Acid	Acid	1	140	600												
Foundry B	1	1915	1.0	Snyder	Acid	Acid	1	140	300	300	864	605	1,550,000	2,000	775	12	10	Crucible	20.5	27.8	Steel castings
	1	1919	3.0	Pittsburgh	Either	Acid	3	55/110 to neutral	1,000												
Foundry C	1	1916	1.5	Snyder	Acid	Acid	1	140	500	450	1728	1296	7,174,000	2,830	750	12	24	Converter	47.4	55.0	Steel castings
	1	1917	3.0	Pittsburgh	Either	Acid	3	55/110 to neutral	1,000					6,700							
Foundry D	1	1916	3.0	Heroult	Either	Basic	3	100 bet. phases	750	200	1558	1094	2,523,000	3500	840	12	10	New plant	18.6	23.2	Steel castings
Foundry E	1	1916	1.5	Snyder	Acid	Acid	1	140	500	150	985	739	3,816,000	5,550	690	12	24	Crucible	44.4	28.8	Steel castings
	1	1916	1.5	Snyder	Acid	Acid	1	140	500												
Foundry F	1	1917	1.0	Rennerfelt	Either	Acid	2	100	400		467	302	958,000	1,400	685	9.5	10	Crucible	29.5	30.7	Steel castings
	1	1918	3.0	Pittsburgh	Either	Acid	3	55/110 to neutral	1,000	225	1181	1152	461,000	800	575	2.5	10		21.4		
	1	1917	12.0	Pittsburgh	Either	Basic	3	55/110 to neutral	3,000												Alloy steel and gun ingots cast to government specifications
Alloy steel mull G	1	1917	12.0	Pittsburgh	Either	Basic	3	55/110 to neutral	3,000	300	5513	2736	10,411,000	13,000	800	12	24	New plant	21.6	....	
	1	1917	1.5	Pittsburgh	Either	Basic	3	55/110 to neutral	600												
Foundry H	1	1918	3.0	Pittsburgh	Either	Acid	3	55/110 to neutral	1,000	150	1613	1469	1,670,000	2,400	695	6	10	Converter	23.6	....	Steel castings
Foundry I	1	1919	1.5	Pittsburgh	Either	Acid	3	55/110 to neutral	600	100	....	....	.....	.....	...	...	...	New plant	...	....	
Foundry J	1	1919	3.0	Von Bauer	Either	Acid	2	105/120	900	150	....	....	.....	.....	...	...	...	New plant	....	....	
Foundry K	1	1919	3.0	Heroult	Either	Acid	3	100	900	450	....	....	.....	.....	...	...	...	Converter	....	....	
Totals	18	....	57.5	.....	.....	.....	.....	.....	17,250	2590	....	....	29,833,000	40,180	....	....	....	.....	.....	.....	.....

* All electrical records include demand and energy consumption of furnaces, and all the lighting and power required throughout the plant because the consumptions could not be separated.

cent in some of the polyphase installations. The power companies usually agree that 50 per cent is an undesirably low power factor, but, on the other hand, they often find that 90 per cent power factor is too high. The latter is usually the case with small companies and on heavily loaded lines of the larger companies where it is considered good practice to sacrifice somewhat on the power factor in order to get the cushioning effect of additional reactance. The more desirable figures are probably 70 per cent to 75 per cent power factor for small power stations and 80 per cent to 90 per cent power factor for the larger ones. The reactance is usually obtained by increasing the magnetic leakage in the transformers, but when the inherent reactance of the transformers is found to be insufficient external reactance is added to supply the deficiency.

The kilowatt demand and kilowatt-hour consumption per ton of steel vary somewhat with different types of furnaces, but the results are found to depend to a much greater extent upon whether a furnace is operated acid or basic, upon the size of the furnace, upon the daily hours of operation and upon the melter. Electric steel furnaces do not require electricians to operate them economically. A metallurgist is preferable who will use common sense and watch carefully the electrical conditions indicated by the meters. Of course, no melter can keep a furnace from consuming 50 kw.-hr. to 200 kw.-hr. more per ton of steel when running basic and refining than when running acid and simply bringing scrap steel up to the proper pouring temperature. However, under similar conditions, one melter can easily consume 100 kw.-hr. per ton more than another in similar furnaces and under practically identical conditions of operation. Two of the plants listed in the table have the comparatively high consumption of 800 kw.-hr. or more per ton, because they were the only two plants that operated basic and refined during 1918.

As the demand for better castings increases and specifications call for lower sulphur and phosphorus content, basic-lined electric arc furnaces are expected to come into general use. This will probably mean higher unit power consumption with lower load factors than when running on acid steel. However, the load factors shown in the table for 1918 can be improved upon. The demand month by month is very uneven during that year. Instead of having a steady load, the demand in almost every case increased steadily up to November, and the average for the year was much below the peak condition upon which the load-factor figures are based. Even the 1917 load factors could be increased, and they probably will be when the operators begin to realize that a little more attention to the electric furnace meters will reduce the bills for electric service.

Books Received

PRINCIPLES OF TRANSFORMER DESIGN. By Alfred Still. New York: John Wiley & Sons, Inc. 216 pages, 67 illustrations.

EXAMPLES IN MAGNETISM. Third Edition. By Prof. F. E. Austin. Published by the author at Hanover, N. H. 90 pages, 27 illustrations.

"THE ELECTRICIAN" DIRECTORY AND HANDBOOK OF THE ELECTRICAL ENGINEERING AND ALLIED TRADES. The Blue Book, 1919. London: Benn Brothers, Ltd. 1330 pages.

STEAM VERSUS ELECTRICITY FOR AUXILIARY DRIVE

A Comparative Study of the Heat Efficiency Derived from Steam and from Electrically Driven Machinery in a Power Plant

BY E. L. MARTHELEUR

ALTHOUGH the varying operating conditions of power plants make almost impossible a definite statement as to the advisability of steam as compared with electric drive for auxiliaries, the former is usually more efficient where exhaust steam can be used for heating purposes. When determining the advantages of one or the other, the power consumption is most conveniently expressed in heat consumption rather than in developed horsepower. A specific instance has been studied in the plant of the Acadia Coal Company, Ltd., where a Lea-Courtenay two-stage pump having a capacity of 270 gal. (1020 l.) per hour against a 370-ft. (110-m) head is in operation. The efficiency of this pump is 54 per cent, and it is driven by a 50-hp. Terry steam turbine using steam at 150 lb. pressure (10.5 kg. per sq.cm.) and 200 deg. Fahr (110 deg. C.) superheat. The steam consumption of this turbine is 45 lb. (20 kg.) of steam per brake-horsepower. An induction motor of 50 brake-hp. capacity would be needed to drive this pump.

COMPARATIVE ANALYSIS OF ELECTRIC AND STEAM DRIVE

The heat analysis and heat efficiency are as follows:

Group Driven by Electricity.—The electric energy is supplied by a plant whose main generator consumption is 14.9 lb. (6.8 kg.) of steam per kilowatt-hour at a steam pressure of 150 lb. superheat, 200 deg. Fahr. The heat content of each pound of steam at this state is 1300 B.t.u. The heat balance of the main turbo-generator is as follows:

	Per Cent
Heat available at switchboard as electrical energy	17.8
Heat lost in condenser	74
Heat returned to boiler in condensate steam	2.1
Heat dissipated in lines—turbines, generator, etc.	6.1

The theoretical horsepower required for the boiler feed pump is:

$$(270 \times 8.34 \times 370) \div 33{,}000 = 25.3 \text{ hp.}$$

Taking into account the efficiency of the motor and pump, the horsepower input will be 50 hp. or 37.3 kw.

To produce 37.3 kw. the main turbine requires:

$$37.3 \times 14.9 \times 1300 = 723{,}000 \text{ B.t.u.}$$

These 723,000 B.t.u. are utilized as follows:

	B.t.u.
17.8 per cent available at switchboard	123,000
74 per cent dissipated in condenser	535,000
2.1 per cent returned to boiler	15,000
6.1 per cent losses in line, turbine-generator, etc.	44,000
Total	723,000

Out of the 129,000 B.t.u. required to operate the motor driving the pump, only 25.3 hp., or $25.3 \times 2547 = 64{,}200$ B.t.u., is required to elevate the water. The rest—64,800 B.t.u.—is lost in the motor and in the pump.

		B.t.u.
1.	Total heat supply	720,000
2.	Theoretically required to produce output of pump	64,200
3.	Returned to boiler in condensate steam	15,000
4.	Losses in condenser	535,000
5.	Losses in motor and pump	64,800
6.	Losses in line, turbine, generator	44,000

The total B.t.u. per hour usefully employed (items 2 and 3) = 79,200. The heat efficiency is then

$$(79{,}200 \times 100) \div 723{,}000 = 10.95 \text{ per cent,}$$

efficiency by electric drive.

Group Driven by Steam.—1. Total B.t.u. required to operate pump by turbine auxiliary: $1300 \times 45 \times 50 = 2{,}925{,}000$.

2. Theoretically required to produce output of pump = 64,200 B.t.u. Heat available for heating apparatus: $45 \times 50 = 2250$ lb. at atmospheric pressure. Heat content per pound = 1150.4. Total heat available = $1150.4 \times 2250 = 2{,}590{,}000$ B.t.u.

3. Heat lost in heater by radiation: 10 per cent = 259,000.

4. Remaining available for heating purposes: $2{,}590{,}000 \times 0.9 = 2{,}331{,}000$ B.t.u.

The total B.t.u. per hour usefully employed (items 2 and 4) = $2{,}331{,}000 + 64{,}200 = 2{,}395{,}200$ B.t.u. The heat efficiency is then: $2{,}395{,}200 \div 2{,}925{,}000 = 82$ per cent.

These values show the great advantage of the steam drive compared with the electric drive on account of the intermediate losses occurring in the generator, condenser, etc. This is true in spite of the fact that the thermodynamic efficiency of the turbine driving the pump is extremely low and the steam consumption of the turbo-generator driving the electric motor is also low. Although the quantity of heat involved is much greater to produce the same output with the direct turbine drive, the greatest part of this heat is easily recuperative for heating purposes.

Considering the boiler and furnace losses, the efficiencies of electric and steam drive under the conditions named would be 8.2 per cent and 61.5 per cent respectively at 75 per cent boiler efficiency. This makes steam drive about seven and one-half times as efficient as electric drive, provided that the exhaust steam is fully utilized. If none is utilized, then the electric drive will be five times as efficient as steam drive and the disadvantages of steam drive requiring four times as much steam as electric drive would make it doubly objectionable.

MORAL worth . . . has contributed fully as much as the magnificent resources of their country to the brilliant success of the American people. Of the qualities that have coöperated to elevate them so rapidly to such a commanding position the most impressive is a great, a tireless energy. It seems to me that the first care of the Americans should be to maintain it in all its integrity. The essential condition to the development of energy is liberty. Every restriction on liberty, with however good purposes, diminishes the individual responsibility and initiative. Yet we often hear mooted in America, as elsewhere, measures which, under the pretext of correcting abuses, would immeasurably extend the state's field of action and reduce the liberty of the citizens. It is my earnest hope that the American democracy will reject such enervating proposals and will remain true to the virile and liberal traditions that have insured the United States so wonderful a growth.—*M. Pierre Leroy Beaulieu, "The United States in the Twentieth Century."*

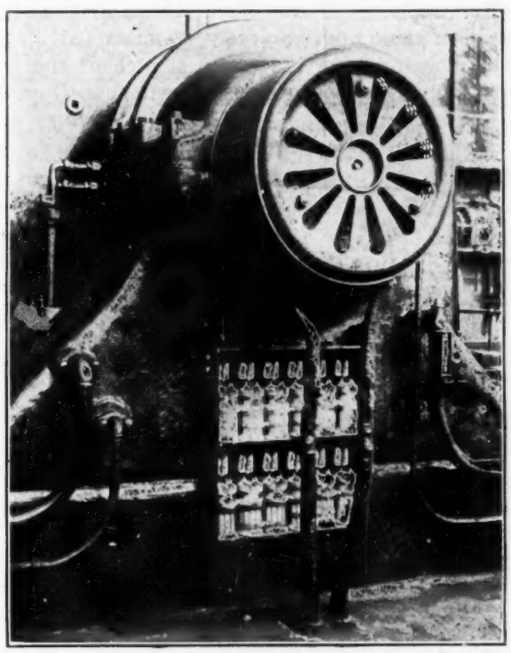
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

BY-PASS ARRESTERS PROTECT GENERATOR-FIELD INSULATOR

Connected Across the Machine Field, They Have Prevented Punctures of Insulation Due to Line Surges

Opening the field circuit of generators or abnormal conditions on the system may induce voltage surges in unprotected field windings of sufficient magnitude to break down the insulation. If care is taken to reinsulate the windings before they are too old to resist these surges, the trouble will be largely obviated, but



ONLY SHORT LEADS ARE REQUIRED TO CONNECT ARRESTERS MOUNTED UNDER COLLECTOR RINGS TO FIELD WINDING

constant watching for this condition entails time and often breakdown occurs before any precautionary steps are taken. Very satisfactory results have been obtained in the stations of the Union Electric Light & Power Company of St. Louis by the installation of by-pass arresters to divert voltage surges and thus to protect the field insulation.

In this company's station twelve aluminum-cell direct-current individual-fused arresters are mounted in a cabinet 26 in. (66 cm.) high by 26.75 in. (68 cm.) wide by 6 in. (15 cm.) deep on the outboard pedestal of a 4500-volt, three-phase, 60-cycle, 1800-r.p.m., 25,000-kva. solid-pole turbo-generator. The arresters are placed in parallel across the field winding, the location being ideal for a short connection to the field leads.

Prior to the installation of the by-pass arresters, the company experienced considerable trouble due to punctures of the field insulation, but none has been experienced since that time. Because the generator had previously been reinsulated, however, this is not an absolute indication that complete immunity has been accomplished.

Other installations show that under the same conditions the number of cells needed is proportional to the exciting current required by the field winding. A by-pass arrester connected across a 250-volt solid-core turbo-generator field will limit the induced potential to about 600 volts when the field circuit is opened. Laminated fields require somewhat greater cell capacity than solid pole fields.

The by-pass arrester, although it has to be initially sharged, requires no special attention thereafter, because it is permanently connected across the field winding.

SPECIAL TRANSFORMERS PROVIDE FOR OVERLOADS

Addition of Water Coils to Self-Cooled Transformers Provides Reserve Capacity at Slight Increase of Cost and in Minimum Space

Central-station primary-power customers would in nearly every case like to install reserve transformer capacity for emergencies or to handle possible increased load, but are often prevented from doing so by considerations of cost or available space. One utility which recommends the use of oil-insulated, self-cooled transformers to its customers on account of the greater efficiency of this type has solved the problem of reserve transformer capacity by advising its customers to have the manufacturer add water-cooling coils to the self-cooled transformers. This sometimes necessitates the use of a larger case, but in general it has been possible to buy transformers as described at a cost of not more than 5 per cent in excess of the price of self-cooled units. Figures obtained from one manufacturer show that copper water-cooling coils increase the cost of self-cooled transformers only by approximately 4

TABLE SHOWING ECONOMY OF WATER COOLING

Self-Cooled Rating, Kva.	Increased Cost of Water-Cooling Coils, per Cent	Increased Rating with Coils in Use, per Cent	Increased Cost of Self-Cooled Units of 50 per Cent Higher Rating, per Cent	
			60-Cycle	25-Cycle
100	4	50	15	25
500	3	50	40	30
1000	2	50	40	30

per cent in units as small as 100 kva., and the rating can be increased 50 per cent. If self-cooled transformers of 50 per cent larger capacity had been purchased, the increased cost would have been about 15 to 40 per cent, as shown in the table.

These combination self-cooled and water-cooled trans-

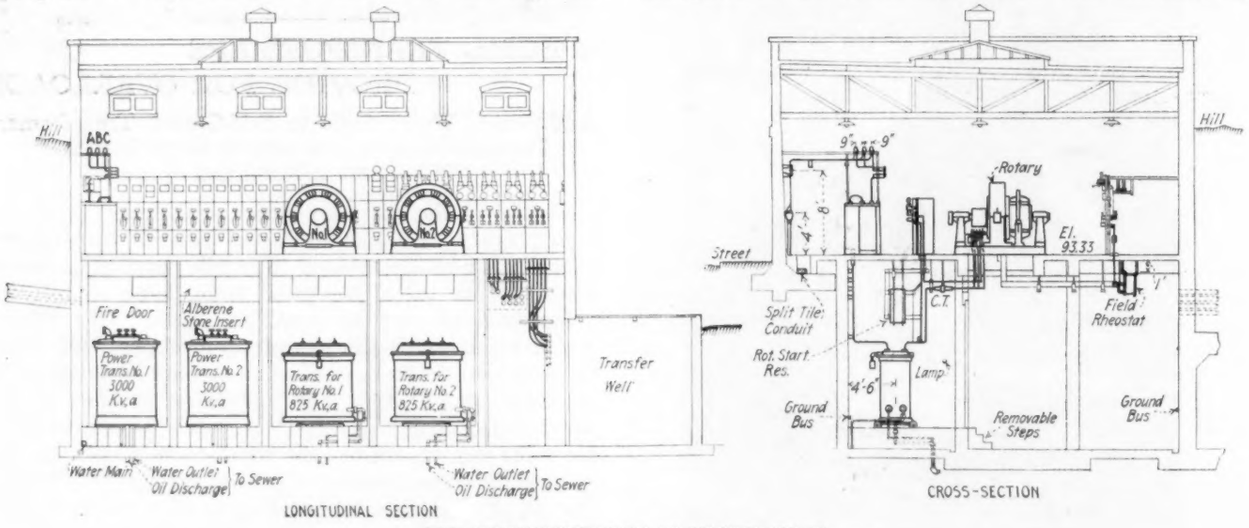
formers provide 50 per cent reserve capacity without any continuous core loss or other operating charge unless the reserve capacity is used. Some central stations also use the same arrangement in their own substations. An instance of this may be found in the substation of a large light and power company in the Middle West, where there are seven 13,800/4500-volt, three-phase, 60-cycle 55 deg. C. (131 deg. Fahr.) transformers which are rated at 2200 kva. when operated as oil-insulated, self-cooled units, but when the water-cooling coils are supplied with 6½ gal. (24 l.) of water per minute at 25 deg. C. (77 deg. Fahr.) the transformers will carry 3000 kva. at the same temperature rise.

LIMITED SPACE REQUIRES COMPACT SUBSTATION

Two-Story Building Houses Transformer and Rotary Converter Equipment for Furnishing Both Alternating and Direct-Current Energy

A substation containing 7650 kva. in power and lighting transformers was designed for the Fisk Rubber Company, Chicopee, Mass., in connection with a recent program of improvement by the Harry M. Hope Engineering Company, Boston, which had to be made to occupy an exceedingly limited space with a street on one side and a hill on the other. In a space about 50 ft. (15 m.) long by 40 ft. (12 m.) wide are located transforming, switching and other equipment supplying a connected load of about 8000 kw., and a two-story building was required. The energy supply to the Fisk company is obtained from the 13,200-volt lines of the Turner Falls Power & Electric Company, and operates both direct-current and alternating-current motors and an extensive lighting system. Two 1000-kw. rotary converters are provided for the 220-volt direct-current motor load.

The substation is about 40 ft. (12 m.) high, the basement being about 18 ft. (5.5 m.) high and providing ample ventilation for the rotary converters through floor openings under the latter. All the direct-current connections of the rotaries are of copper-bar type. The transformers are of the water-cooled type and are arranged for removal on trucks running into a transfer well. Both alternating-current and direct-current switchboard sections are located in line on the operating room floor, and all feeders to the building are in underground conduit.



TWO-STORY SUBSTATION IN LIMITED SPACE

MODEL OF RIVER MADE TO STUDY WATER CONDITIONS

Plan Sometimes Used for Ice Disposal in Hydroelectric Plants Cannot Be Used in Chippawa Development on Account of Location of Rapids

The plan often adopted for ice disposal at hydroelectric plants is to let the ice pass into the forebay with excess water and then to divert enough water back into the river again to carry the ice off with it. This plan can only be used where there is enough energy available to draw off the water and ice, and therefore the forebay must be located in rapids or else the power canal must pass close to a part of the river which is at a considerably lower level than the forebay.

In the Chippawa development being engineered by the Hydro-Electric Power Commission of Canada there is an open canal approximately 13 miles (21 km.) long, carrying water from the upper stretch of the river at Chippawa to the power house down near Queenstown, and thus making available almost all of the head due to the difference of levels between Lakes Erie and Ontario. The rapids start some distance below Chippawa, where the intake is located, and therefore at the latter place the river has only a slight slope so that the methods of ice disposal employed at other plants at Niagara are not available here. Furthermore, the canal is some distance back from the river and ice runs cannot be easily taken from one to the other, and the great length of canal makes it all the more important that no ice should enter it which can be avoided.

In order to devise some good plan, a model of the Niagara River has been built to a scale one-twentieth full size, this model being an exact reproduction of the river and Chippawa Creek. The velocities are about quarter those of the actual river; the depth of the water corresponds exactly to scale with the depth of water in the river.

Intakes of various shapes and sizes were put in and their effect both on the distribution of the water in the

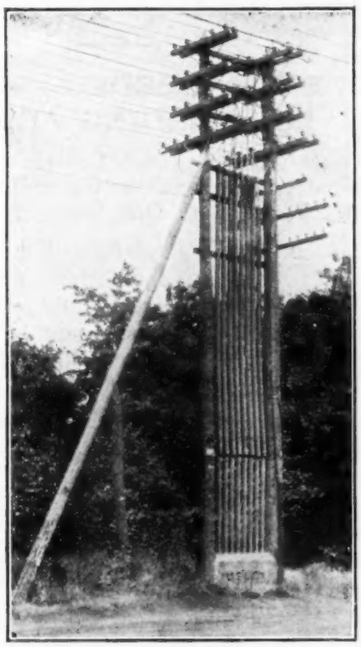
river and on ice was studied. The ice was represented by blocks of oak water-soaked so as to represent closely the same specific gravity as ice.

The general type of intake was that with slots in the bed of the river, and various forms of cover both at the outer and inner ends, and also different forms of diverting walls and baffles, were used. The shallowness of the river at the point under consideration, only about 15 ft. (4.5 m.), very much limits the type of intake which may be adopted. This information was supplied by Robert W. Angus, professor of mechanical engineering at the University of Toronto, who has been in charge of the test work.

TWO-POLE STRUCTURE MAKES LOW-COST LINE TERMINAL

Eight Vertical Cable Risers Between Poles Convey Lines from Underground to Overhead—Diagonal Pole Counteracts Tension

A convenient overhead-underground line terminal consisting of two 45-ft. (13.5-m.) poles and eight cable risers, has been made by the United Electric Light Company of Springfield, Mass., at an expense of only $200. At the bottom of this structure, which was designed by W. H. Bolewine, superintendent of distribution, is a 6-ft. by 5-ft. by 8-in. (2-m. by 1.5-m. by 20-cm.) reinforced concrete ground box through which connections are made to a manhole. The structure,



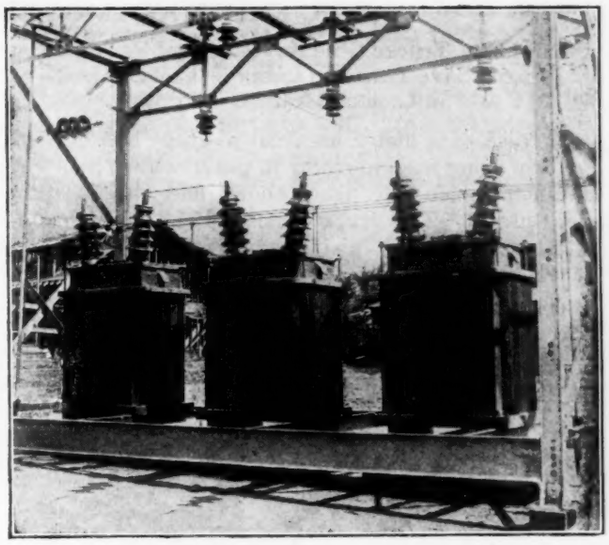
STRUCTURE SUPPORTS EIGHT TRANSMISSION WIRES, TWO FOUR-WIRE POWER CIRCUITS, TWO STREET-LIGHTING WIRES AND LOCAL TELEPHONE AND FIRE-ALARM CIRCUITS

which is braced by a 35-ft. (10.5-m.) diagonal pole, carries two street-lighting wires, eight transmission wires and two four-wire power circuits. The right-hand pole is equipped with extension cross-arms carrying local telephone and fire-alarm circuits. The vertical cables are lead-covered, and cross-tied mechanically by four cypress moldings. Five 0.5-in. (1.3-cm.) stranded steel guy wires are installed at the right side of the structure.

IRON TRANSFORMER MOUNTING INCREASES FLEXIBILITY

Entire Substation Structure Can Be Easily Moved Without Constructing Individual Concrete Bases for Transformers

Instead of constructing a concrete base for each transformer in an outdoor substation a transmission company in the South utilized an I-beam and angle-iron frame which supports the lightning arresters, etc., to



TWO I-BEAM CROSS PIECES FOR EACH TRANSFORMER

hold the transformers above the ground. Two small I-beams were attached to the main larger ones by means of bolts to support each transformer. This method eliminated the necessity of building a concrete base for each unit or a large base for the three transformers and is especially desirable if it is necessary to change the location of the station. In the station shown in the transformer secondary leads are attached to wire buses running the length of the station, which are dead-ended to angle-irons through insulators.

This station was designed by C. O. Lenz, consulting engineer.

Motor Operated as Induction Generator

In some mills in New England that formerly used water and steam power but now employ central-station service some induction motors that have been released from service in the mills have been connected to the old waterwheels and driven as generators to pump back into the electric service lines. The waterwheels are still used for mehanical power in the high-water season so that the water power is not wasted. The generators are started up as motors from the central-station supply, with no water running through the wheels. Then water is admitted and the machines are driven above synchronous speed. Heretofore when load was thrown off the wheels they tended to "run away" because no regulating devices were attached, but now the induction motors hold them down in speed because they pump back into the central-station lines. One of the motors which is driven as generator is a 75-hp. General Electric type I form K machine with a synchronous speed of 900 r.p.m. It is driven at 920 r.p.m. to deliver 30 kw.

INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

SIMPLE AND QUICK MEANS FOR SHIFTING MOTORS

Small Dolly Trucks Obviate the Use of Portable Crane and Save Time and Labor — Can Be Used in Case of Motor Breakdown

In case of a motor breakdown when it is desired to quickly bring a spare motor to the spot for replacement, the home-made dolly truck shown herewith has proved very useful. This truck consists of an 18-in. or 24-in. (45-cm. or 60-cm.) platform on rollers which can be

LIGHT-WEIGHT TRUCKS HANDY IN TRANSPORTING MOTORS IN CASE OF AN EMERGENCY

moved by means of an iron handle bolted securely to the truck. The distance between the top of the platform and the floor is 3 in. (7.5 cm.), the end being tapered off to a thickness of about $\frac{5}{8}$ in. (15 mm.), and covered with a $\frac{1}{8}$-in. (3-mm.) piece of sheet steel. The motors can be slid from the truck directly to the floor or vice versa.

Trucks of this type are being used in the plant of Robbins & Myers, Springfield, Ohio.

PULL-OUT FORCE DETERMINES RIGHT MOTOR SIZE FOR SAW

Forty-eight-Inch Saw, Requiring Over 127 Hp. for Nine Seconds, Driven by Meano of Standard 40-Hp. Motor

The majority of wood and metal saws are used intermittently and they therefore are not likely to become overheated on account of underrating. However, a motor must be obtained with a sufficiently high pull-out force to carry the maximum load required.

This requirement was found in a veneer mill to be especially important where it was estimated that it would take a 48-in. (1.2-m.) circular saw about ten seconds to cut through 12-ft. (3.6-m.) logs, and that the power required would be 120 hp. The motor recommended for this use was a standard 40-hp., three-phase, 60-cycle, 220-volt motor with a pull-out force of three times full-load torque. The test on the motor soon after it was installed showed the following results:

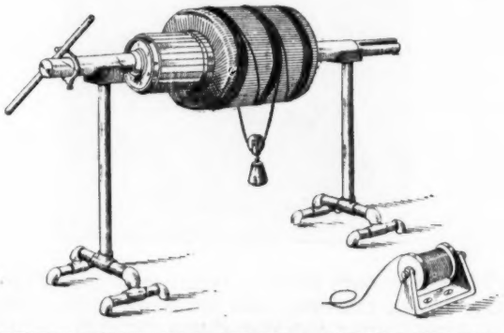
Test No.	Input, Kw.	Output, Hp.	Per Cent Power Factor	Remarks
1	1.8	.....	14.5	Motors only
2	4.8	4.02	32.0	Motor 48-in. saw
3	44.8	57.64	73.0	Ripping 15-in. by 12-ft. logs in nine seconds
4	73.2	95.7	81.6	
5	96.8	127.0	83.5	

The logs were mounted on a positive feed carriage and ripped into boards. The maximum load of 127 hp shown in the test was obtained when the saw was ripping through the center of the log. This is as heavy a load as the motor is called upon to carry. Sixty-inch (1.8-m.) saws are sometimes used and are often embedded practically up to the hub. The speed of the carriage is then necessarily reduced, however, and the amount of power taken is no greater than that shown above. The direct connection of the motor to the saw shaft was considered, but the saw sometimes meets with obstructions in the logs, and a belt drive was considered to give greater flexibility. The motor is protected by an oil switch equipped with inverse-time-element overload relays.

ONLY ONE MAN NEEDED FOR BANDING ARMATURES

Wire Is Wound in Banding Slots Loosely and Armature Is Rotated in Opposite Direction with Weighted Pulley Hung from One Loop of Wire

Since armature banding, performed in the ordinary manner, usually requires the participation of more than one person, and is practically the only operation in an armature repair shop that does, it may be inconvenient at times to carry on this work because of difficulty in



WEIGHTED PULLEY IN PLACE FOR PRODUCING TENSION IN BANDING WIRE

securing helpers. However, this difficulty has been eliminated in one shop by employing this method:

The free end of the banding wire is soldered to the armature anywhere and the latter rotated by means of a "dog" and pipe as indicated in the illustration until the wire has filled all of the banding groves. In per-

forming this operation no tension is exerted on the banding wire. Next, the remaining end of the wire is soldered to the armature and a weighted pulley hung on a loop of the banding wire nearest this end.

By selecting a weight twice as heavy in pounds as the desired tension in pounds per square inch the wire will be drawn up to the correct tension by rotating the armature backward. At any time when it is necessary to adjust the position of the banding wire this can be done easily by the person turning the armature because the tension will not be relieved as would happen when banding in the ordinary manner.

G. H. VESCELIUS,
Foreman Belyea Electric Machinery Company.
New York City.

SAFETY PROVISIONS IN LIGHTING GRAIN ELEVATORS

Some Objections to Both Carbon Lamps and Gas-Filled Lamps Are Made by Inspection Departments of Different States

Experiments in grain elevators have developed the fact that fires may be started by wheat dust collecting on an ordinary 16-cp., 55-volt carbon-filament incandescent lamp. It has been further shown that the ignited dust may drop to the floor and start a fire if it falls into a pile of rubbish and waste. As the result of these tests some inspectors are recommending the inclosure of carbon lamps in vapor-proof fittings or the use of vacuum-type tungsten lamps. Inspectors in other states, including Arkansas, are also objecting to the use of gas-filled lamps, unless they are protected, for the same reason.

EFFECT OF VARNISH UPON COIL CHARACTERISTICS

Advantages and Disadvantages of Varnishes for Use on Coils of Electrical Apparatus—Slow-Drying Varnishes Favored

An important factor concerning insulating varnishes is that the dielectric resistance increases directly with the length of baking or drying period, the slow varnishes imparting the highest degree of insulation and flexibility and producing a tough, flexible film which may also be depended upon for mechanical strength and extreme durability. Black varnishes are claimed to be better for work where a transparent coating is not absolutely essential because they produce a more flexible and highly insulating film than clear varnishes of the same class. Varnishes should not crystallize under prolonged vibration, and their mechanical structure should be elastic and homogeneous. The accompanying table gives the characteristics, uses, drying time and solvents of several varnishes.

The information from which this table was compiled came from the Mitchell-Rand Manufacturing Company.

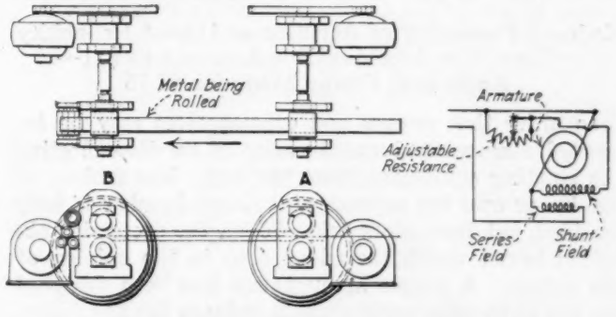
CHARACTERISTICS OF VARNISHES

Kind	Some Uses	Characteristics	Time to Dry (Hrs.)	Drying Temp. (Deg. Fahr.)	Solvent
Clear baking varnish	Linen, canvas, cotton tapes, paper fiber, coils, armatures, etc	Penetrating and elastic; oil, waterproof and heat-resisting	6–8	212	Benzine
Black baking varnish	Motor repairs, coils, armature, transformers, ignition cables, asbestos	Prevents absorption of moisture, resists oil, heat, water and acid	4	275	Benzine
Clear air drying	Coils, molding fiber, etc	Water, oil and acid resisting and insulating	4–20	Avg.	Benzine
Black air drying	Coils, general repair work	Water, oil and acid resisting and insulating	4–8	Avg.	Benzine
Clear finishing varnish	Finishing of apparatus	Oil and water resisting, flexible and insulating	1–3	Avg.	Denatured alcohol
Black finishing varnish	Motor frames, coils, laminations	Oilproof, tough and durable	1–3	Avg.	Denatured alcohol
Clear core-plate varnish	High-voltage electric machines, transformers	Water, oil and acid resisting	1	Avg.	Benzine and benzol (9:1)
		Heat conducting	1/12	275	
Black core plate	Insulation of armature and transformer lamination	Waterproof and acid resisting	5–10 min.	Avg.	Benzine and benzol (9:1)
			1–2 min.	200	

CONTROL FOR TANDEM BRASS-ROLLING MILL DRIVE

Methods by Which Loads of Two or More Independently Driven Stands Are Equalized When the Mills Are Operated in Tandem

Tandem rolling mills may be installed with an independent motor to drive each mill, and the loads on the different motors can be kept constant to within about 10 per cent of each other by changing the strength of the shunt-field winding of over-compounded direct-current motors which are used to drive all but one of the stands. The characteristics of the motor which does not have field control should be that of the straight shunt motor with approximately constant speed at all loads. Even better for some installations is the differentially wound compound motor, which would compensate for the slight drop in speed that would occur if the motor was shunt-wound.



METHOD OF CONTROLLING BRASS ROLLING MILL

The load first comes on the motor when the bar enters stand *A* and remains constant until it reaches stand *B*, which immediately tends to pull it faster than stand *A* had been delivering it. The drop in the motor line current as indicated on the ammeter shows to what extent stand *B* is actually pulling on stand *A*. By adjusting this ammeter drop and keeping it within a reasonable amount of say 10 per cent of the load carried, there is always some tension on the bar and no tendency for stand *A* to feed the metal ahead of stand *B* and thereby cause a buckle which might injure the guides or crimp the bar itself. The wiring connection shown to the right is for the motor-driving stand *A*. When more than two mills are in tandem the same arrangement is used on all but the last stand. A shunt-wound motor is used to drive the last stand of rolls, which in the illustration is stand *B*.

The field adjustment on each motor is made only on the first bars of any batch of material passing through the mill. For this purpose a line ammeter is used in

the motor circuit, the entire system working automatically after the adjustment has been made for any given width and gage of materials. Slight variations in the hardness and thickness of material being rolled and the resultant change in motor input will be compensated for by changes in the speed of the over-compounded motors. As the motors change in speed the tension in the strip of material being rolled will vary. The connecting metal acts like a rope or cable and tends to throw a certain portion of the torque required to turn the first stand of rolls on to the motor driving the rolls through which the metal next passes.

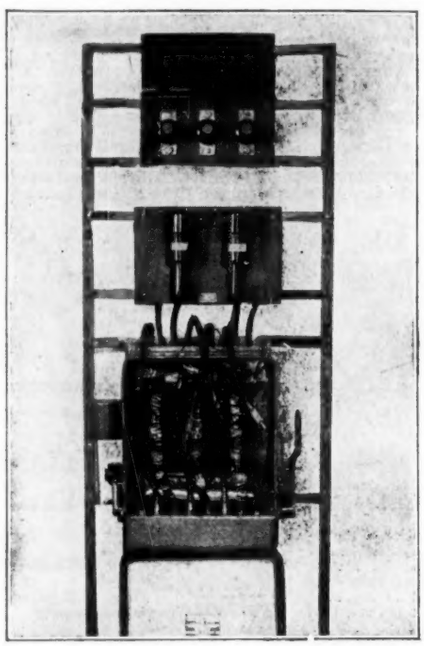
W. R. CLARK.

Bridgeport (Conn.) Brass Company.

HOME-MADE ISOLATING PANELS FOR THREE-PHASE MOTORS

Reduced Possibility of Accident and Great Reliability —Total Cost Including Box Amounts to $11— Angle-Iron Frame Made for $4.75

In order that motors and compensators may be inspected, some method must be afforded for disconnecting the starting equipment from the line. For motors of 100 hp. or over the expense of a circuit-breaker is fully justified, but for motors below 75-hp. the protection obtained is not worth the added cost, in the opinion of the writer. A simple arrangement has been designed for the latter-size motors which reduces the possibility of fire and accident to a minimum and provides a cheap

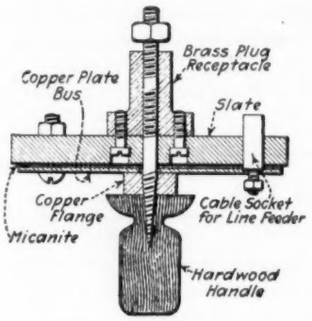


ANGLE-IRON FRAME HOLDING ISOLATING PANEL, OVERLOAD RELAY AND COMPENSATOR

method of isolating the equipment for inspection and repair. The frame illustrated supports a General Electric overload relay and compensater for use with 550-volt, 60-cycle motors subjected to considerable fluctuation.

In the line diagram the details of the isolating panel are shown. This panel is inclosed in an iron box which can be locked shut. The incoming buses are connected to the cable sockets and a double lead is taken from the brass-plug receptacle, one going to the line side of the compensator and the other to fuses on the overload relay. To insure perfect contact the flange of the plug is "ground in" on the bus. Multiple units can be made where a number of motors are to be operated from the same position.

A printed notice is placed close to the panel to remind the electrician not to open the plugs unless the compensator is in the off position. Otherwise considerable arcing would probably destroy the device. By taking the plugs from their receptacles and locking them up, the repairman is assured that no one will replace them while he is working on the compensator. These plugs are more reliable than knife switches and have many times their contact area.



DETAILS OF PLUG

The total cost of construction was $11 including the inclosing box; the angle-iron framework was made at an expense of $4.75.

L. E. WOOD.

Valleyfield, Quebec.

POWER-PLANT EQUIPMENT FOR PULP AND PAPER MILLS

Combination of Steam and Electric Drive Can Often Effect Higher Economy than Either Alone Will Accomplish

The power demand in paper mills varies widely with the product manufactured, but in all cases a large amount of steam is required for drying the paper, and also for heating the buildings in winter. Therefore steam drive is usually thought economical on account of the complete utilization of the exhaust steam. However, if this is done in a large plant it requires a number of small engines, which usually are not of the highest efficiency.

Motor drive can be employed with all the advantages of steam propulsion and electric power combined by using bleeder-type turbines which automatically take care of the fluctuation of both power and steam demanded. In an old mill, operating with reciprocating engines which are in good condition, and having an excess of exhaust steam, it is thought that a low-pressure turbine is the ideal machine to install. The low-pressure turbine will receive the excess exhaust steam from the reciprocating engines and utilize its available energy in producing additional power, the boilers supplying no more steam than before the low-pressure turbine was installed. Another similar condition sometimes exists where some of the beaters, etc., are driven by a large engine located in the power house or adjacent to it, and the remaining machinery is driven by small, less efficient engines and complex shafting. In a case like this greatly improved economy can be obtained by using a low-pressure turbine in connection with a generator supplying power to motors driving the machines not taken care of by the large, efficiently operating reciprocating engine.

These suggestions were made by engineers of the Westinghouse Electric & Manufacturing Company.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Methods for Increasing the Use of Electric Light, Power and Heat

HOW TO MAKE FARM SERVICE BUSINESS PAY

Analysis of Customer Costs and Transformer Losses Shows that Even with Minimum Charge of $5 Company May Only Break Even

A wrong impression about the lucrative element in farm electric service is often induced by the fact that the income per customer is higher than the average income per city customer. If a company is charging farmers a monthly minimum of $5, the manager is likely to look at that $60 annual revenue as quite satisfactory to come from a residential customer. However, it is the opinion of A. H. Latimer, Calmar (Ia.) Electric Company, that central-station executives would do well to analyze their cost of serving farmers.

Mr. Latimer has analyzed some of his own costs on this type of customer as follows: "Our farmers are served in groups from 2300-volt circuits which in turn are fed from high-tension lines. Those who are served alone from a 2300/220/110-volt transformer pay $5 a month minimum charge with an energy rate of 10 cents per kilowatt-hour for the first 50 kw.-hr. and 8 cents for all additional. Where two or more farmers take service from the same transformer they pay a $3 monthly minimum and an energy rate of 15 cents per kilowatt-hour for the first 20 kw.-hr. and 8 cents for all additional. For both classes of farmers there is a cooking rate of 4.5 cents for the first 50 kw.-hr. per month and 4 cents for all additional. This latter is considered too low because estimates show that it costs about 4 cents to produce and distribute electricity to farmers near Calmar.

"Along with these data on rates the usual customers' transformer losses should be considered. On Duncan 2300/220/110-volt transformers, figuring core losses as a constant factor and copper losses as equal to the full load copper loss for two hours in each twenty-four hours, the losses would be:

2-kw. transformer in 30 days consumes in losses 23 kw.-hr.
3-kw. transformer in 30 days consumes in losses 27 kw.-hr.
5-kw. transformer in 30 days consumes in losses 36 kw.-hr.
7½-kw. transformer in 30 days consumes in losses 48 kw.-hr.

"Taking now as an illustration the best conditions under which the company could serve farmers, suppose that two farmers were being supplied from a 5-kw. transformer and that they used only the amount of their minimum. Each would pay $3 monthly. All energy sold would bring 15 cents per kilowatt-hour, the annual revenues being $72 from the sale of 480 kw.-hr. Transformer losses would amount to 432 kw.-hr. annually, making the total energy supplied 912 kw.-hr. This at 4 cents per kilowatt-hour would cost $36.48. On the basis of $500 invested per service (which in this case serves two customers) the upkeep and overhead at 7 per cent would make an additional expense of $35 a year. The total cost of service would be $71.48 and the revenue would be $72.

"Consider now an actual case which may be more typical. A customer served from a 3-kw. transformer used 903 kw.-hr. in a year, consuming 156 kw.-hr. for lighting and 747 kw.-hr. for cooking. Add to this transformer losses of 324 kw.-hr. and the total energy supplied will equal 1227 kw.hr., which at 4 cents a kilowatt-hour will cost $49.08. To this must be added upkeep and overhead at 7 per cent on an investment of $350, which equals $24.50. This investment is of course made by the farmer. This makes the total cost of giving service $73.58. For this the company received $60, the minimum charge, because the customer only used about four-fifths of the energy to which he was entitled. This same customer, had his service been metered on the primary side of the transformer, would have paid $80.76 for the year's service, showing a profit of $7.18 instead of a loss of $13.58. However, primary metering would not have solved this problem if the investment had been $500 instead of $350. A solution of such cases may be found by making a charge against the consumer for upkeep. Central stations should not make the mistake of thinking the farmer will be unwilling to pay these charges. He will be willing to pay if he is shown what he is paying for.

DATA ON EARNINGS FROM FARM CUSTOMERS

Amount of Reading at Customer's Meter in Kw.-Hr.	Minimum Required	Size of Transformers Used in Kw.	Total Energy Supplied at Transformer in Kw.-Hr.	Total Cost of Service.	Am'ts Rec'd for Service	Profit	Loss
1033	$60	5	1465	$83.10	$94.56	$11.46	
903	60	3	1227	73.58	60.00		$13.58
426	60	3	750	54.50	60.00	5.50	
367	60	3	891	52.14	60.00	7.86	
271	60	1½	247	46.38	60.00	13.62	
675	60	5	1107	68.78	65.76		3.02
(245)	72	3	960	73.40	90.07	16.67	
391							
(300)	60	1½	576	48.90	60.00	11.10	
430	60	4	810	56.90	60.00	3.10	
Totals						$69.31	$16.60
						16.60	
						$52.71	

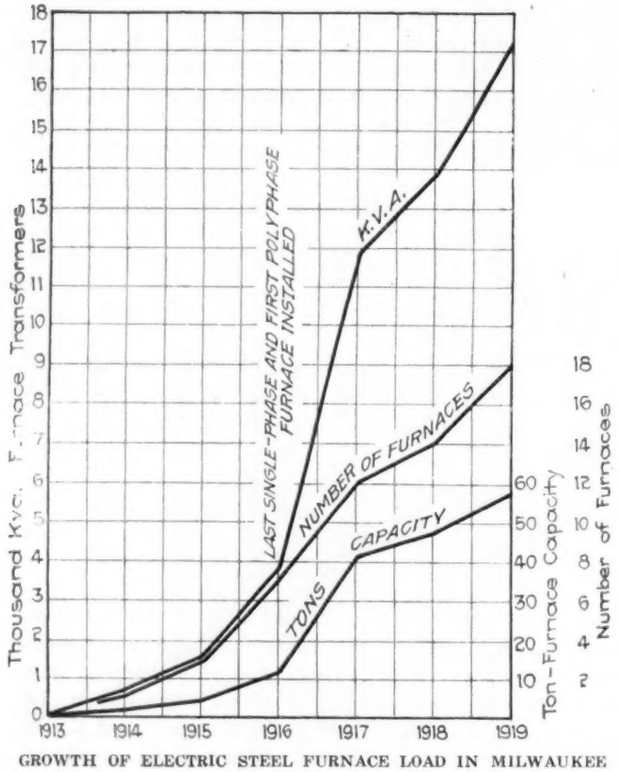
"While the foregoing examples are open to some criticism as being isolated cases, a more thorough survey of a group of ten farmers served from 2300-volt circuits shows practically the same situation. Data on these ten customers are given in the table herewith. Upkeep and overhead are figured at 7 per cent on an average investment of $350 except where two customers are served from a single transformer. In this case the investment figure was $500 for the two. According to this the average annual profit is $5.27 a customer.

While Mr. Latimer pointed out the possibilities of increasing income by primary metering and by charging for line upkeep, he also expressed the belief that more accurate data from actual operation of lines should be secured by putting totalizing output meters on farm lines at the point where they are fed.

UTILITY SERVES LARGE SINGLE-PHASE LOADS

Milwaukee Company Connected Single-Phase Steel Furnaces to Tie Lines Until Customers Learned that Polyphase Furnaces Have Wider Field

Eight years ago there were no electric steel furnaces in Milwaukee, whereas now the city has eighteen such furnaces, thanks to the far-sighted policy of the Milwaukee Electric Railway & Light Company, which supplied single-phase service in order to give some of the foundry men an opportunity to try out the cheapest kind of electric furnace first. In 1912, when the first



GROWTH OF ELECTRIC STEEL FURNACE LOAD IN MILWAUKEE

electric steel furnace was installed on the lines of the Milwaukee company, the foundrymen in that district looked on an electric furnace as an experiment, and they would not spend much money to find out what it would actually do. The power company recommended that the steel men use any of the polyphase furnaces then on the market because they had better metallurgical and electrical characteristics than the single-phase furnaces offered.

These single-phase furnaces were limited for all practical purposes to acid operation, and an acid-lined furnace is nothing more than a melting pot which must be charged with high-grade steel before equally good steel can be poured. Practically all the polyphase furnaces, however, may be operated either acid or basic. The advantage of basic operation is that the best-grade steel can be refined from low-grade scrap.

The foundrymen may have thought the central station favored a polyphase furnace because it meant a balanced load on its lines at a high power factor, whereas the single-phase furnace under consideration operated at about 50 per cent power factor and would unbalance the company's lines. Be that as it may, the foundrymen would not consider the higher-priced three-phase unit. The single-phase furnace looked simple and cheap and one prospective customer intimated that he would try one of these furnaces in his foundry if the electric company could supply the service.

The power company had great confidence in the future of the polyphase arc-type steel furnace and felt that even if some of the foundries did start with single-phase furnaces it would only be a matter of time before the demand would switch to the polyphase type. The company's engineers were therefore instructed to forget its rules and all preconceived ideas regarding single-phase loads and to find some way of taking on some single-phase furnaces. The company had some extra-large three-phase, 25-cycle tie lines between its railway substations and a surplus feeder capacity between the substations and its generating stations. It was therefore decided to supply service to a few single-phase furnaces and connect them to the tie lines.

The first furnace installed was rated at 1 ton and was supplied with energy from a 500-kva. single-phase transformer. The foundry found it necessary to melt faster than had been anticipated so that the transformer was later changed to a 700-kva. unit. The substation tie lines were of such large capacity that no serious trouble was experienced on account of unbalance, but there were some disturbing effects due to the very low power factor of this kind of furnace. The first one was connected in 1914, two more single-phase furnaces were installed in 1915, and three in 1916. While the load was unbalanced on the tie lines, the furnaces were so connected that the load on the generating stations was not greatly out of balance.

The six single-phase furnaces, with their acid linings, melted down high-grade steel scrap to the entire satisfaction of the foundrymen. When high-grade scrap is cheap or when output is required irrespective of cost or quality, it may be even preferable to operate a furnace acid. However, when good grades of scrap are expensive basic operation is generally more economical, and when steel must be made to meet a rigid chemical analysis basic operation of a furnace is practically essential. This turned the attention of the single-phase furnace operators to the advantages of polyphase furnaces, which could be operated either basic or acid as conditions required, and the steel men came to realize that they were handicapped in their business when they were confined to acid operation.

By the time the six single-phase steel furnaces had been installed the load on the company's inter-substation tie lines reached a point at which the addition of any more furnaces of the same type would be detrimental to the operation of the system. However, the single-phase furnaces had served their purpose. They proved to the steel founders of the district that the electric arc furnace was a practicable and profitable furnace for melting down steel, and the operators were now ready to admit the claims of those who were refining steel in basic line furnaces. It worked out therefore that the steel men and the electric company both agreed that the characteristics of the polyphase furnace were best. The first polyphase furnace was installed in the Milwaukee district in the same year that the last single-phase furnace went in, and since that time eleven more polyphase furnaces, two of which were rated at 12 tons each, have been connected.

BOSTON COMPANY ANALYZES SIZE OF LIGHT CUSTOMERS

Results of Study by R. S. Hale and F. E. Smith of Single Month's Applications Show Interesting Distribution of Business

That more lighting customers use from eight lamps to ten lamps apiece than make use of any other number has been the experience of the Edison Electric Illuminating Company of Boston. R. S. Hale and F. E. Smith set forth the results of an analysis by the special research department and the statistical division of the sales department of the number of equivalents connected per customer, and this was printed in the June issue of *Edison Life*, the publication of the company.

To arrive at a proper estimate of the average number of equivalents connected was more difficult than at first appeared, the investigators found. Dividing the total load in kilowatts by the number of customers gave an average corrected load of seventy equivalents. There were obviously comparatively few customers using as many as seventy equivalents, the high figure being due to the industrial customers.

The authors of the paper therefore discarded the average in its ordinary sense, using instead the "median" and the "mode." The former represented a customer of the middle size; that is, if the median customer used fifteen equivalents, there were just as many customers using less than fifteen equivalents as more than fifteen. Thus the median was not affected appreciably by a few users of large amounts of energy. The mode, on the other hand, is the number occurring most frequently; in this case it was the number of equivalents most in demand.

On account of the magnitude of the task no attempt was made to ascertain the median and mode for the entire business of the company, the March applications only being studied. The applications showed far more customers of six, eight, ten, twelve, fifteen and twenty lamps than of any other numbers, the obvious reason for this being that applicants tended to use round or even numbers, or numbers divisible by five. For instance, a customer with nineteen or twenty-one lamps, or even one with as few as seventeen or as many as twenty-three, might put down twenty as his quota.

March applications showed the mode, or number of lamps which more customers wanted than any other, to be between eight and ten, while the median was found to be twelve. These figures applied to lighting only. If power customers had been included, although the median and mode would have remained unchanged, the average, in the ordinary use of the term, would have been twenty-one, this showing how a few large customers affect the average but do not affect the mode or the median.

The average number of lamps per lighting customer for the company's entire business was twenty-seven, excluding power customers, and the average number of equivalents, including power customers, was seventy. The reason why the averages for the whole business were so much larger than for March was that no very large customers applied in that month.

Based on these figures, it was estimated that the company has more users of eight, nine or ten lamps than any of the other numbers, and that there were just as many customers using under twelve lamps apiece as over that number. The average number of lamps per lighting customer was found to be twenty-seven, and the average number of equivalents, including power, seventy.

COMMERCIALIZING THE OPENING OF A PLANT

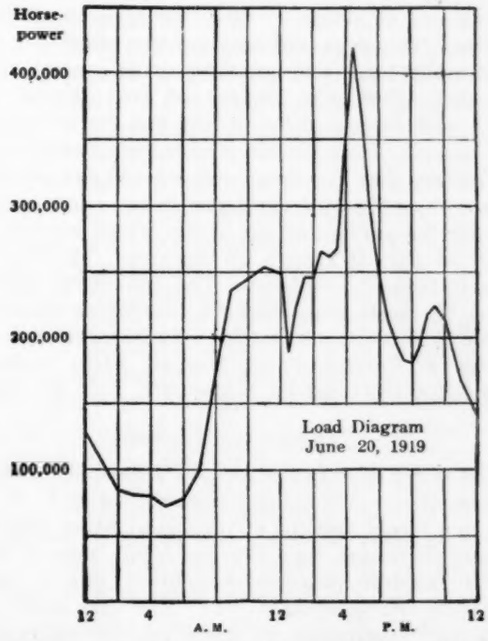
Starting of a New Unit Is Used at Reading, Pa., as an Opportunity to Show Large Power Consumers Something About Company Operations

That every large user of power should be given an opportunity to see the station from which he receives his supply is the belief of H. E. Dawson, commercial sales manager of the Metropolitan Edison Company, Reading, Pa. When a new unit is started a splendid opportunity is provided for a celebration at which large consumers are guests.

Recently, when the new 20,000-kw. generator of this company was started, invitations were sent to members of the Chamber of Commerce, the Rotary Club and the Kiwannis Club and to city officials. In connection with the inspection trip, a buffet lunch was served and moving pictures were displayed.

One of the features of the program was the complete absence of speech making. Descriptive cards were placed on each point of interest and numbered. A souvenir program was given to each guest with a further description of each point of interest. The program also contained some pictures and facts about the plant. When the day was over the officials of the company felt that their guests had been greatly interested in the station and had gone away with a better knowledge of utility problems and an appreciation of the efforts made to serve them.

Record Peak Load of New York Company



A sudden storm on June 20, with resulting daylight darkness, sent the afternoon demand on the New York Edison Company from 250,000 hp. up to 425,000 hp. The magnitude of the increased demand, its suddenness and the change in percentage were without precedent in the company's thirty years' history, but the record load was successfully handled.

DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

How Spacing and Thickness of Brushes Affect Commutation.—WARREN C. KALB.—The writer discusses how the spacing, alignment and thickness of brushes may cause circulating currents to flow in the armature windings, and thereby develop poor commutation.—*Power*, June 24, 1919.

Transformers for Overload Operation.—J. MULLER.—Standard lists for transformers give the rating for continuous operation, but the load to be supplied is frequently such that the transformers should be selected on an overload basis, otherwise, if standard transformers be chosen for possible overloads, the equipment will be unnecessarily large, and there will be large light-load losses. It is rational to build special types for overload service, and the author gives formulas showing how any standard transformer may be adapted to overload operation.—*Science Abstracts, Section B*, April 30, 1919. (Abstracted from *Elektrot. u. Maschinenbau*, March 25, 1917.)

Substitute Materials in Electrical Apparatus.—The report of the Dortmund inspector of mines contains references to the experiences gained with substitute materials used in electrical apparatus. Although such materials have enabled many problems to be solved, yet many results have been disappointing. Zinc has proved unreliable for the contacts of switches, as it is liable to changes of shape, so that the area of contact decreases. In cables and busbars zinc may only be used if specially large and carefully made contact areas are provided. Controller fingers of iron should be provided with copper plates to take the sparks at breaking the current. Iron slip rings have been found unsuitable for motors that are frequently started and stopped. In such motors the heat developed in the rings is sufficient to melt the surface of the rings, which solidifies glass-hard, so that it cannot be machined. Rubber cannot be satisfactorily replaced. The substitutes are all inferior in mechanical strength, insulating qualities and power to withstand moisture.—*Technical Supplement to Review of Foreign Press*, May 13, 1919. (Abstracted from *Elektrotechnische Zeitschrift*, Feb. 27, 1919.)

Lamps and Lighting

The Gas-Filled Lamp and Its Effect on Illuminating Engineering.—The subject as discussed by F. W. Wilcox before a recent meeting of the Illuminating Engineering Society indicates that the gas-filled lamp is likely to modify modern practice in lighting, due to the three following characteristics: (1) The very high intrinsic brilliancy (estimated at 3,000 cp. per sq.in.) due to the high temperature of incandescent and the spiralized form of the filament, (2) the provision of large units of high candlepower and increased efficiency, (3) the alteration in the form of filament.—London *Electrician*, June 6, 1919.

Lighting Without Hanging Ceiling Fixtures.—J. L. STAIR.—The writer deals with the new tendency in lighting practice toward concealed lighting units. He discusses the illumination of churches, theaters, schoolrooms and other places where it is desirable to use concealed fixtures in cornices, on columns, etc.—*Electric Journal*, May, 1919.

Generation, Transmission and Distribution

Standard Practice of Hand Firing.—ROBERT JUNE.—The writer discusses standard practice for hand-firing boilers, taking up the problem of covering up thin spots, keeping the fire of proper thickness, abating the smoke, and keeping down the smoke in the case of banked fires.—*Electrical Review*, June 7, 1919.

Insuring Durability of the Pole-Top Fittings.—CHARLES R. HARTE.—The author considers means of attaching cross-arms to the pole, bracing them in place, and providing insurance against breakdown under everyday and emergency strains. He takes up in some detail the specifications for wood cross-arms for the American Electric Railway Association.—*Electric Railway Journal*, June 21, 1919.

Steam-Electric Plant of the Dominion Power & Transmission Company.—In the *Electrical News*, dated June 1, the turbine and auxiliary steam equipment was dealt with, while in the present article the electrical generators and auxiliary equipment are discussed. The generators are 12,500-kva. Westinghouse generators, 6600 volts, three-phase, 66⅔ cycles, operating at 2000 r.p.m. The field coils are insulated for a temperature of 150 deg. Centigrade without injury, while the armature is insulated with material subject to temperature of 90 deg. Centigrade without injury. These generators are cooled with air treated by special generator humidifiers, two humidifiers to each three generators. Both steam and electrically treated exciters are installed in this plant.—Toronto *Electrical News*, June 15, 1919.

Traction

Electrification of Steam Road Results in Service and Success.—The Centerville, Albia & Southern Railway Company, now operated by the Iowa Southern Utilities Company, was converted from a steam to an electric road in 1914. Centerville is surrounded by an extensive coal field, and a number of mines were developed along the line. These mines provide a good source of revenue, not only from the coal shipped out of the mine, but the company also furnishes energy for the mines, which are all operated electrically. The railway also transports the miners to and from their work. On account of the fact that there are very few north and south roads in Iowa, on most of the lines running east and west considerable passenger traffic has been developed.—*Electric Traction*, May, 1919.

1918 Data for the Pioneer Constant-Speed Electrification.—E. MARSHALL.—Data are given concerning the

operation of the electrified traction of the Great Northern Railway in the Cascade tunnel. The trains here operate on a 1.7 per cent grade. The electric locomotives are equipped with four three-phase 25-cycle slip-ring induction motors, running at a synchronous speed of 375.4 r.p.m. The normal capacity of each motor is 250 hp. The following data are taken to indicate the economy of operation for the year 1918:

Freight mileage	24,528
Return (idle) mileage	24,528
Passenger mileage	13,020
Passenger (idle) mileage	13,020
Special mileage	12
Special (idle) mileage	12
Total	75,120
Tons 1 mile, cars and contents	8,461,770
Passenger train cars, 1 mile	48,096
Average gross tons per engine-mile	345
Average haul is double the above, or	690
Cost of repairs, total	$5,653.91
Miles per pint of oil, valve	313
Miles per pint of oil, engine and car	19
Cost per mile for repairs in cents per mile run	7.53
Cost per mile for wages in cents per mile run	27.39
Cost per mile for lubricants in cents per mile run	0.2
Cost per mile for supplies in cents per mile run	0.33
Cost per mile for total in cents per mile run	35.45

—*Electric Railway Journal*, June 21, 1919.

Installations, Systems and Appliances

A New Type of Electric Furnace.—AXEL SAHLIN.—The furnace which is described in this paper has been designed with a view to embodying the advantages of both the direct-arc and the free-burning arc furnaces, at the same time avoiding as far as possible the disadvantages of both. The arrangement of electrodes is shown in the illustration. Advantages claimed for

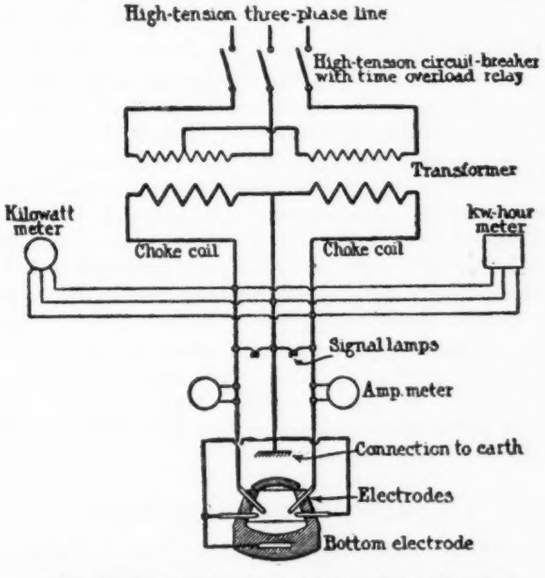


DIAGRAM OF CONNECTIONS FOR SAHLIN FURNACE

this furnace are as follows: The construction is extremely durable, rigid and simple. All the surfaces of the brick linings are convex and the walls therefore are held in position. The surface of the melting room, confined by spherical and cylindrical walls, is the smallest possible for the largest volume, and the amount of brickwork in the furnace is therefore reduced to a minimum. The electrodes are easily secured in place, adjusted, advanced or retracted by means of handwheels. There are no bolts or nuts manipulated by wrenches used in the adjustment of the furnace, the operation being carried out by handwheels or cotters. The roof is solid without any openings, removable and exchangable in a minimum space of time. The furnace can be run either with free-burning arcs, with direct arcs or with free-burning and direct arcs burning simultaneously, side by side. Changes are made without cutting off the current. The Sahlin furnace has not yet been placed on the market, but a furnace is now being built in Great Britain intended for the production of steel ingots and castings.—Toronto *Electrical News*, June 1, 1919.

Electricity as Applied to Loading and Unloading Coal and Ore Boats.—R. H. MCLAIN.—The application and advancement of electricity in loading and unloading coal and ore during the past twenty years are detailed by the author. The increase in handling capacity and the enlarging of dock areas served by handling machinery have been a necessary development due to the importance of steel and coal as related to the nation's industries.—*General Electric Review*, May, 1919.

Electric Welding: Its Theory and Practice.—H. S. MARQUAND.—In the present article the author deals with electric arc welding and after some general discussion of the subject proceeds to the consideration of the equipment generally used in the process. A description is given of power equipment at present available, after which the author passes to the subject of electrodes, electrode holders and protective devices.—London *Electrician*, May 16, 1919.

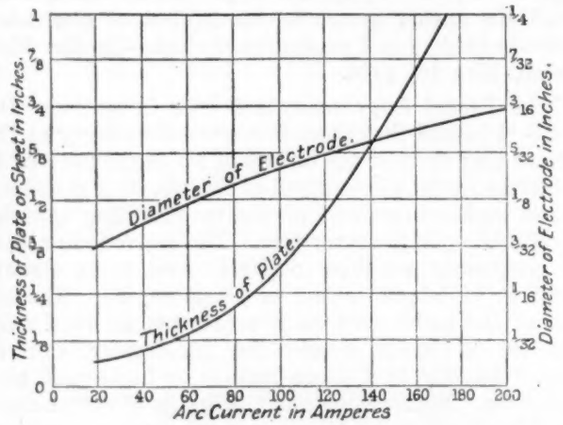
Some Recent Improvements in Air Compressor Design.—It is said that there is a marked tendency at the present time to raise the output of air compressor units by increasing the piston speed of reciprocating machines, and to replace machines of the reciprocating type by those of the purely rotary type. The desire is to couple the compressor wherever possible direct to an electric motor or high-speed steam or petrol engines. The advent of the turbo-compressor represents an ideal solution in all cases where the compressor can be coupled directly to a steam turbine or high-speed electric motor. Improvements in the design of compressors for this direct connection to rotary driving machines are fully discussed.—London *Engineer*, May 30, 1919.

Apparatus for Testing Magneto Magnets.—G. MARTINEZ.—This is of the generator type, the apparatus comprising an armature and pole-pieces and the field magnet being the permanent magnet to be tested, which is placed in position for the test. A voltmeter connected to the generator terminals gives readings proportional to the flux for a given speed which is read from a tachometer. The flux can then be determined. A red mark is put on the voltmeter side to indicate a flux value which the magnets must at least attain. The coercive force is determined by means of two windings in a direction opposing the magnet's flux, and the current required to reduce the voltmeter reading to zero is noted.—*Science Abstracts, Section B.* (Abstracted from *Elettrotecnica*, Jan. 25, 1919.)

Electrically Driven Plate Mills.—G. W. HANEY.—The electrical and mechanical features of the new plate mill of the Brier Hill Steel Company at Youngstown are dealt with. Electric drive is used throughout the plant. The plates, which are the sole product of the plant, are rolled in two mills, one a three-high, one-stand mill, having a width of 132 in. (3.3 m.), the other a two-

stand mill 84 in. (2.1 m.) high. The roughing stand of the 84-in. mill is driven by a reversing direct-current motor supplied with energy from a flywheel motor-generator and the three-high finishing stand is connected to a continuous alternating-current motor rated at 2500 hp. A 5000-hp. alternating-current motor drives the 132-in. mill. All power for operating the plant is supplied by the Republic Railway & Light Company through two three-phase, 60-cycle, 66,000-volt lines to the company's step-down transformer substation, which is of the outdoor type. Diagrams are printed showing the switching scheme and also the high-tension bus arrangements and switchboards.—*Electric Journal*, May, 1919.

Electric Welding: Its Theory, Practice and Application.—In this number of the series the author discusses briefly the Slavianoff, the Kjellberg and the quasi-arc systems, and that of the British Arc Welding Company. The author states that whichever one of these processes is used, the current required with various sizes of electrodes is about the same. The accompanying curves give specific data on the average values of currents and diameter of electrodes for welding mild-steel plates. To find the diameter of the metal electrode required, select, for instance, a $\frac{3}{8}$-in. (9.5-mm.) plate and follow horizontally to the thickness of plate curve; the vertical line through this intersection represents about 110 amp.


Thickness of Plate or Sheet in Inches.
Diameter of Electrode in Inches.
Diameter of Electrode.
Thickness of Plate.
Arc Current in Amperes
0 20 40 60 80 100 120 140 160 180 200
1 7/8 3/4 5/8 1/2 3/8 1/4 1/8 0
1/4 7/32 3/16 5/32 1/8 3/32 1/16 1/32

DIAMETER OF ELECTRODES AND CURRENT FOR MILD-STEEL WELDING

as the most suitable current to be used for this size of plate. Then follow this vertical line to its intersection with the diameter electrode, which locates a horizontal line representing approximately $\frac{5}{32}$-in. (7.9-mm.) diameter of electrode. In a similar manner a $\frac{1}{2}$-in. (1.27-cm.) plate will be seen to require 125 amp. with a $\frac{5}{32}$-in. (7.9-mm.) electrode. The mechanical preparation for the plate for welding is also described.—London *Electrician*, June 13, 1919.

Electrochemistry and Batteries

Accumulators in the War.—At the outbreak of war the German industry was faced with a tremendous call for batteries for submarines. In this connection the success of F. Bayer & Company in producing synthetic rubber was of the greatest value for the manufacture of battery boxes. The output of synthetic rubber reached 150 tons per month in 1918 at a price of 37 marks per kilogram. The army used large quantities of accumulators for lighting automobiles, signaling by arcs and wireless, lighting dugouts for gun crews and reserves, and lighting aircraft. The transport of cells for charging necessitated the substitution of celluloid for glass boxes to save weight. At first the celluloid was defective, particularly in its cementing, but the quality improved later. The prevention of spilling the acid was achieved by a number of ingenious devices, generally consisting of chambers connected with the interior of the boxes by small tubes in such a manner that the acid could not flow out of the ventilating openings. The need of small stationary batteries rose greatly owing to the ever-increasing dearth of petroleum and other illuminating substances, and produced a great scarcity of lead, which rose to 90 marks per 100 kilograms. The prospects of the industry are very bad, owing to the cost of raw materials and the rise of wages and the limitation of working hours. This will probably lead to the scrapping of batteries, which will not be economical to repair any longer. Furthermore, the use of batteries on automobiles will be strictly limited by the probability that the use of automobiles will be forbidden, owing to the lack of fuel, oil and rubber.—*Technical Supplement to Review of Foreign Press*, May 13, 1919. (Abstracted from *Elektrotechnische Zeitschrift*, Feb. 20, 1919.)

Units, Measurements and Instruments

Factors Entering Into Brake Tests.—The principles of several types of loading brakes are discussed and information is given pointing to the precautions that must be taken to secure correct data in the use of these brakes.—*Power*, June 17, 1919.

Measurements on the Electrodeless Discharge.—The conductivity of the electrodeless discharge is measured for a series of gases (nitrogen, oxygen, air and carbon dioxide), and in no case is a maximum conductivity found to exist in the region of pressure of 1 to 2 mm. mercury. The maximum in this region noted by Wachsmuth and Winawer is regarded as a secondary effect not primarily connected with the electrodeless discharge. Tables are given showing the dependence of the conductivity on the frequency and spark potential. Mercury vapor shows effects analogous to those with the above gases, the maximum value of the conductivity being about 400 times the corresponding value for air at the same excitation. Further tests indicate that the maximum energy is absorbed at a pressure lying between 0.1 and 0.2 mm., and it is therefore probable that the maximum value of the electrodeless discharge takes place within these limits, while the conductivity only reaches its maximum at 0.02 mm. pressure, below which pressure the glow at the discharge vanishes.—*Technical Supplement to the Foreign Press*, May 13, 1919. (Abstracted from *Schweizerischer Elektrotechnischer Verein, Bulletin*, March, 1919.

Telegraphy, Telephony and Signals

Heterodyne Envelopes.—J. ST. VINCENT PLETTS.—When a received oscillation has superimposed upon it a locally generated alternating current of a different frequency, a pulsating oscillation is produced. It is the magnitude, frequency and shape of the pulsation which determines the interference or beat note heard in the telephone when the pulsating oscillation is rectified. The note heard, therefore, depends entirely upon the envelope of the pulsating oscillation, or upon what is called the heterodyne envelope, which is here investigated methematically and also diagrammatically by means of a set of illustrative curves.—London *Wireless World*, June, 1919.

Book Reviews

RADIO PAMPHLET NO. 40, SIGNAL CORPS, U. S. A. Superintendent Public Documents, Washington, D. C. Illustrated.

This book fills a field which has heretofore been unsatisfactorily covered. It was produced by a group of writers assembled by the Bureau of Standards under the direction of Dr. J. H. Dellinger and the Signal Corps. It was designed not exactly as a text, but rather as a book to be placed in the hands of elementary radio students, non-commissioned officers of the Signal Corps and men studying to be non-commissioned officers to provide the information by which able men could train themselves to understand the principles of radio. The result is a book which satisfies any one as regards the physics, not only of radio itself, but of electricity and magnetism, electrical circuits and electrical machinery, which of course are of use in connection with radio-communication. Besides, it can easily be read by a person who has not had any mathematics, and at the same time is extremely interesting and useful to one who is better equipped with the fundamental tools. The table of contents does not show much difference from some works which have been produced before, but the manner of presentation—the appeal to the innate ability of a man who has not a good education—is somewhat novel. Not only would a man know something about radio when he got through the book, but he would know a great deal about electricity when he got through the first half. It is a book which should be appreciated by all amateur radio men and by all who are seeking a readable yet thorough book on electrical principles, circuits and machinery.

INDUSTRIAL ELECTRICAL MEASURING INSTRUMENTS. By Kenelm Edgcumbe. New York: D. Van Nostrand Company. 414 pages, 260 illustrations.

This is the second edition, enlarged and fully revised, of an earlier book by the same author and of the same title. It was printed in Great Britain during the war, which gives the book an additional claim to consideration. Books on electrical measuring instruments have often been written as textbooks for electrical engineering students, with abundant mathematical discussion so as to elaborate the quantitative principles involved. In this case, however, the book has been written by an engineer for engineers, with ample arithmetical illustration but with no emphasis on algebraic discussion. The result is a thoroughly practical reference book which can be understood by nearly all those who use the instruments described. A valuable feature of the book which will commend it to the practical man is the general use of the metric system of weights and measures throughout. Not only is the descriptive text thereby greatly simplified, but the arithmetical illustrations are also made much shorter and easier. Many English technical books are marred and made unpopular by straining at the retention of old English units of measure that perhaps no one clearly understands, under the vain belief that electrical engineers prefer grains, ounces and inches to grams and millimeters. The illustrations are numerous and uncomplicated. Vector diagrams are largely relied upon to explain the principles of alternating-current instruments. There is a full index of subject matter and a complete list of illustrations. The symbology and direction of vector rotation advocated by the International Electrotechnical Commission are used throughout. The book is likely to be a favorite with users of electrical measuring instruments, especially those instruments which are in general use in Great Britain.

ESSENTIALS OF ALTERNATING CURRENTS. By W. H. Timbie and H. H. Higbie. New York: John Wiley & Sons, Inc. 374 pages, 223 illustrations.

The alternating current is commonly regarded as a very complex phenomenon bristling with mathematics at every phase. It is true that there are complex aspects to the science of alternating currents and that advanced textbooks on alternating currents frequently employ mathematical analysis. Nevertheless, the salient and essential phenomena that are necessary for understanding the first principles of alternating currents are very simple when simply expressed. This book is a good elementary textbook on the fundamentals of alternating-current circuits. It employs simple geometrical or vector diagrams, but it is devoid of either algebra or trigonometry. It uses simple arithmetic generously. There are, in addition to an appendix, ten chapters dealing with the following topics: Modern systems of power transmission, transformers, impedance, power and power factor, current and voltage relations, impedance resistance and reactance, polyphase circuits, calculation of wire sizes, motors, converters and rectifiers. The book is excellently adapted for private study by those who seek to acquaint themselves with the fundamental quantitative relations of alternating currents but have not had a mathematical training. There are numerous arithmetical problems distributed through the text.

"THE ELECTRICIAN" ELECTRICAL TRADES DIRECTORY AND HANDBOOK, 1919. London, England: Benn Brothers Ltd. 1331 pages.

The thirty-seventh edition of the above directory and handbook contains about eighty pages more than the 1918 issue, mainly due to an increase in the number of items in the alphabetical and classified trades sections of the British and colonial divisions. The editors call attention to considerable improvements which have been effected in the arrangement of the contents, including the thumb holes and table which make reference to the different sections of the directory an easy matter. The directory is divided into six main divisions; (1) British Division; (2) Colonial Division; (3) Continental Division; (4) Asiatic and African Division; (5) Central and South American Division; (6) United States Division. The handbook section of this useful publication contains approximately 450 pages of engineering data and other useful reference information concerning British associations and electrical activities. This section also gives details of Board of Trade regulations and London County Council regulations, together with other rules covering electrical installations such as municipal electric supply rules, etc. The first directory section of the volume gives names classified according to professions and trades for the British Division. The names are arranged alphabetically. The second, third, fourth, fifth and sixth sections give similar information for the Colonial Division, Continental Division, Asiatic and African Division, Central and South American Division and United States Division.

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Coöperative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

NATIONAL RESEARCH COUNCIL INVESTIGATES INSULATION

Plans for Coöperation with Engineering Societies and Other Recent Activities of the National Research Council Are Outlined by Col. F. B. Jewett

The engineering division of the National Research Council has recently organized a special committee for research in the field of insulation and insulating material, of which Col. F. B. Jewett, chief engineer of the Western Electric Company, is chairman. While it is as yet too early to report anything in the direction of definite action, it is the thought of the engineering division that through this committee certain coöperative research work of an essentially fundamental character might be possible, and that this work, which might not otherwise be undertaken, will prove of material benefit to the electrical industry as a whole.

"Concerning the organization of the National Research Council as a whole," Colonel Jewett says, "engineers will be particularly interested in the engineering division. This division, in common with the other divisions of the council, is a permanently organized body with a permanent chairman and vice-chairman. At the present time the chairman is Dr. H. M. Howe and the vice-chairman is G. H. Clevenger. While the headquarters of the National Research Council and most of the divisions are in Washington, the headquarters of the engineering division are in room 1603 of the United Engineering Societies Building, New York, this location having been chosen because of the desirability of keeping the division in intimate contact with the headquarters organizations of the national engineering societies. Except as regards general matters of policy and coöperative relations with the other divisions of the National Research Council, the engineering division is essentially made up of and controlled by the various engineering societies of the country. As at present constituted, it has, in addition to certain members at large elected by the division itself, a representation from the Engineering Foundation and a direct representation, through appointment by the governing boards, of representatives from the national engineering societies and the larger specialized engineering groups. The Engineering Foundation, which is a large factor in the engineering division, is coöperating intimately with the division in carrying out the intent of its trust.

"It is the aim of the engineering division to stimulate and promote research in those fields which are of interest to the engineering profession and to undertake, through established agencies, the conduct of engineering researches which might not otherwise be carried on. . . . It is the hope and expectation not only of the engineering division but of the National Research Council as a whole that through the activity and stimulus of the engineering division there will develop in the engineering field an enlarged interest and activity in fundamental and specific researches that will prove of material benefit to the engineering profession, to those industries which are essentially engineering in their origin and to the country as a whole."

BRITISH ORGANIZE FOR SCIENTIFIC RESEARCH

Recognize the Need of Trained Research Workers and Arrange for State Encouragement of Pure Research and Organization of Applied Research

As a result of experience with government control of research during the war there has been organized in England, under the Privy Council, the Advisory Council for Scientific and Industrial Research. This body has been assigned a permanent place in the government, and its activities are to extend throughout the empire. The field of usefulness of the council may be set forth under three main divisions, as outlined by Sir Frank Heath in the London *Electrician* for March 7, 1919—(1) the encouragement of research workers; (2) the organization of research by industries, and (3) the organization of national research.

The advisory council confirmed at an early stage the fears of a shortage in the numbers of trained research workers. The plans recommended for the extension of research work will increase the demand for trained workers. The research department has already done something to help those who have shown capacity for original investigation, and it suggests that since men are returning in large numbers from the fighting services to the colleges and universities more than 30,000 can usefully be expended on this service during the next academic year. The method of procedure is as follows: In the first place there are no scholarships or fellowships, applications being made upon the personal responsibility of men of scientific standing. Records are kept of the performances of workers recommended. This delegation of responsibility has worked well, for no one knows a student or worker so well as the man with whom he has worked. The grants made are of four kinds: (1) Maintenance grants to students to enable them to be trained in methods of research; these grants are made for a year but may be renewed for a second year. (2) Grants to independent research workers devoting their whole time to research, whether in pure or applied science; these grants are also made for a year, and may be renewed for a further four years. (3) Grants to a teacher engaged on research to enable him to employ a suitable assistant to help him in his research but not in his teaching. (4) Grants in special cases to a worker investigating some new branch of science to enable a research lectureship to be established in a university, pending the provision of a suitable endowment from other sources. The department has also a close working agreement with the Royal Society.

The advisory council recognized that many of the industries were making less use of science than was desirable. The relatively small size of the majority of British firms, the shortage of well-trained research workers and even of routine workers in science, and the

lack of mutual understanding between the universities and the industries, were some of the difficulties in the road. The best the government could do was to encourage coöperation while leaving the immediate responsibility to the manufacturers themselves. Thus the scheme of coöperative research associations came into being. These associations are limited-liability companies working without profit and with a nominal guarantee from their members in place of shares. The members of each association make an annual subscription usually, proportionate to the size of their business, toward the income of the association.

There remains a growing body of work which the government must do itself, namely, "national research." Here again the policy is one of delegation to persons specially qualified by their knowledge and experience to do the work in hand, with great freedom of initiation. The work may be divided into three classes:

I. A Clearing House of Information.—The department acts as a clearing house of information, but it confines itself to this. The council has been urged to establish or aid in establishing a great central bureau of scientific and technical knowledge.

II. Investigations Carried Out for Other Departments of State.—National research is most important. It deals with investigations carried out for other departments of state. To avoid confusion each department of the government appoints one or more assessors to the advisory council, who furnish the natural channel of informal communication between the department of research and the departments they represent. This device has had the happiest results. It has been possible on more than one occasion to remove overlapping already in existence and to bring the workers under different departments together into a coördinated plan of attack.

III. Research Boards.—The work done by research boards is not only wide in scope but complex in organization. The first board of this kind to be established was the Fuel Research Board, which is concerned with a typical piece of national research. The same thing applies to the preservation of food as to the conservation of coal, and this work is being undertaken by the Food Investigation Board and the Industrial Fatigue Research Board. One further example of a research board is to be seen in the arrangement whereby the government decided to assume the responsibility for the National Physical Laboratory from March 31 last.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Technical Theory and Practice" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

DRY CELLS, ELECTRICAL CHARACTERISTICS AND TESTING OF.

A circular has just appeared (No. 79) in which the available information on dry cells is summarized. A brief description of the materials and methods of construction and an elementary theory of the operation of the cells are given. The various sizes and kinds of dry cells on the American market are described and the electrical characteristics of the cells and method of testing them are discussed. In an appendix are given the proposed specifications for dry cells.—*G. W. Vinal and H. D. Holler, Bureau of Standards, Washington, D. C.*

FREQUENCY OF THE SUPPLY, DIRECT DETERMINATION OF.

A small synchronous motor, similar to the one used in the G. E. oscillograph, is connected to the supply circuit the frequency of which it is desired to determine. There is no d.c. excitation, and the motor runs entirely by armature reaction. A steel wire serves as a coupling which connects this motor to a recording train of gears taken from an old watt-hour meter. The number of revolutions of the motor can be readily determined with a stop watch, and the frequency thus accurately computed.—*H. S. Baker, Hydro-Electric Power Commission of Ontario, Niagara Falls, Ont.*

FUSE CUT-OUTS, FOR TRANSFORMERS.

Some operating companies which have condemned the inclosed-fuse type of cut-out for transformer primaries are experimenting with oil-submerged and other types of fuses, and the development of a cheap and reliable cut-out (for 2200 to 6600 volts) offers an attractive field of endeavor for the inventor.—*N. E. L. A. Committee on Underground Construction.*

GLASS BULBS, RESIDUAL GASES IN.

The investigation of high vacua has been extended by making observations on the effect of sealing off of highly exhausted glass bulbs and noting the subsequent change in pressure with time. A mercury diffusion pump and the Knudsen absolute gage were employed and pressures obtained of the order of 5×10^{-5} mm. Hg.—*J. E. Shrader, Pittsburgh, Pa.*

MANGANIN INVESTIGATION.

An investigation has been made to determine the relation between chemical composition, melting practice, mechanical working and temperature coefficient of resistance of manganin, with the result that we have been able to produce the alloy in bars, sheet or wire form with a better coefficient than any of the imported material and with a lower thermo-electric emf. against copper. We have been able to obtain a temperature coefficient between 15 deg. and 30 deg. C. of from 0.000001 to 0.000003 per degree centrigrade. The melting was at first done in an electric resistor furnace where a large number of small samples were made, and later on a larger scale in a gas-fired pot furnace. We found that we could repeat results of melts made in the electric furnace with melts made in the gas furnace in much larger quantities, provided that the proper precautions were taken. The results of this investigation will be presented in a paper before the American Institute of Mining Engineers at the fall meeting.—*F. E. Bash, Leeds & Northrup Company, Philadelphia, Pa.*

MEASURING INSTRUMENTS, ERRORS IN.

It has been demonstrated that the theory of dimensions of physical quantities may be used in a differential form, a procedure which appears fruitful particularly in investigating the effect of given sources of error on the performance of measuring instruments. The results will soon appear in a scientific paper of the Bureau of Standards, No. 331. The examples which led to the necessity for developing this method are discussed at the end of the paper and illustrated by experimental data.—*Mayo Dyer Hersey, Bureau of Standards, Washington.*

METERS, DEMAND.

An investigation is being made of various demand meters, their performance and methods of demand measurement. Meters on the market and meters recently developed are being studied. The results may be later presented before the A. I. E. E.—*P. A. Borden, Hydro-Electric Power Commission, Toronto, Ontario.*

POLYPHASE SYSTEMS, UNBALANCED LOAD.

A method has been developed for finding graphically the voltages to the neutral in a Y-connected unbalanced load by means of a triangular abaque based upon the given line voltages. The method is applicable only with the same value of power factor in the three branches. The results check quite closely with experimental data.—*L. A. Doggett, United States Naval Academy, Annapolis, Md.*

Suggestions for Research

GROUND CONNECTION, CIRCULATING CURRENT IN.

Where two three-phase plants are tied in parallel, and there is a ground connection in each, a considerable triple-frequency harmonic current may circulate through these connections. One of the inconveniences which this circulating current is reported to cause is its interference with the relays which cut out a defective line. In one particular case there are two outgoing lines in parallel, and the relay is supposed to cut out automatically the grounded circuit. These relays become less sensitive and have to be set for a higher current. One solution may be to devise relays which are selectively sensitive to 60-cycle current and insensitive to 180-cycle current. The whole subject is well worth looking into.—*Editorial Suggestion.*

SWITCH, DISCONNECTING.

It is customary to open disconnecting switches by hand with a good plain wooden stick, even at the highest voltages in use. At 110 kv. the stick is quite long, and it is difficult to get at the locking latch that holds the blade. For new power houses, where the highest obtainable efficiency and safety are aimed at, it is advisable to develop some simple mechanical or electrical means for operating disconnecting switches from a distance.—*Editorial Suggestion.*

TRANSFORMERS, CURRENT.

In some calibration tests on customers' premises, it has been found that the ratio and the phase angle are somewhat affected by the mutual inductance of two adjacent transformers, and also by the magnetic fields of the heavy current leads. Where metering must be done with an accuracy of a fraction of one per cent, these factors are worth being considered. A theoretical investigation and experiments are desired as to the best arrangement of the transformers themselves and of their leads to minimize the disturbing effect of mutual inductance.—*Editorial Suggestion.*

TURBO-GENERATORS, LOSSES IN END-PLATES.

A year or two ago some of my students made a number of measurements of the losses in the end-plates of large turbo-generators caused both by the stray field from the field-magnets and by the field produced by the armature. A great deal of work still remains to be done.—*Miles Walker, College of Technology, Manchester, England.*

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

THE PACIFIC COAST YEAR IN THE N. E. L. A. WORK

President R. H. Ballard, at Meeting of Leading Men at San Francisco, Outlines Policies to Increase Usefulness of Association to Members

President R. H. Ballard of the National Electric Light Association called together in San Francisco on July 9 a score of the leading electrical men of the Pacific Coast and outlined to them the general plan of procedure proposed for the coming year. There were present representatives of the public policy committee and the executive committee of the Northwest Electric Light & Power Association and representative members of the Pacific Coast Section, N. E. L. A. The purpose of the conference, Mr. Ballard said, was to reach a common understanding and agreement as to the best means of attaining desired ends and for the purpose of unifying the efforts of all concerned.

Mr. Ballard Emphasizes Important Topics

A letter sent recently by Mr. Ballard to the four vice-presidents of the national association, read to the conference at the suggestion of John A. Britton, Pacific Gas & Electric Company, named the following topics as among those of primary importance for consideration at this time:

Electrical Resources of the Nation.—To check up electrical development, probably by states, both private and municipal, and to give opportunity to make some comparisons of facts without argument.

Electrification of Steam Railways.—This committee to cover the subject on a broad business basis. An additional committee of engineers to report on the purely technical features might be appointed by the technical section.

Regulation by State Commissions.—This committee to make comparison of methods used by the several state commissions on such questions as valuation and the principles underlying rate of return. This committee might also find ways of reaching sections of the country where decisions are not conducive to attracting capital in the interests of national prosperity.

Public Information.—To devise means of conveying the message of service to the public in such a way as to be accepted by the public. This would doubtless involve the services of an experienced publicity man who could also devote time to making the monthly bulletin more effective.

Employees' Participation.—Covering the present status of welfare work and its good and bad effect upon employees. The question of employees' participation in surplus earnings, of employee stockholders, and the general question of labor, should be handled by this committee.

Other topics emphasized by Mr. Ballard included that of a joint technical committee to check up standardization and prevent the adoption of conflicting ideas, this committee to consist of representatives from the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the N. E. L. A., and, finally, (1) water-power development, (2) coöperation in the industry, and (3) service—"developing the ideal"—committees on the three subjects last named to be headed by Pacific Coast men.

In connection with these suggestions Mr. Ballard pointed out that above all else there should be earnest endeavor "to carry the association to the country." This would be beneficial in inspiring real interest in association affairs, he pointed out, because the individual company or member, situated at some distance from headquarters, likes to hear from time to time from some of the officials of the association. He hesitates to submit matters unsolicited, and if he does not hear something during the year he feels that his section of the country has been overlooked.

The discussion which followed the setting up of these objectives of the year's work was general and developed a readiness to fulfill the slogan "Everybody works." Mr. Ballard made the point that now the Pacific Coast has opportunity to show the men of the East those things about the Pacific Coast which should be known in the interest of closer relationship.

In the discussion on the several committees proposed particular emphasis was placed on the matter of railroad electrification. Large electrification projects are already under consideration on several Western roads, and there was a general agreement that an N. E. L. A. committee should be prepared not only intelligently and comprehensively to answer the questions that will arise on this subject from a broad business viewpoint, but also to see that the results thus far attained are properly placed before the electrical fraternity at large. The standardization of equipment and the phases of the question involved in regeneration (on which the experience of Western roads is of special interest) were mentioned as features of this committee work that would need particular attention by an additional committee composed of engineers. The extent to which Pacific Coast systems are being interconnected is a factor bearing on this question.

Increasing Sectional Activity

Discussing the question of section affairs, those present seemed to be in agreement as to the desirability of increasing section authority and range of activity. A section manager to devote his entire time to promoting the interests of member companies was discussed, as was also the question of ways and means of increasing the service which the association renders.

H. J. Gille, president of the Northwestern Electric Light & Power Association, promised hearty cooperation from his territory. Mr. Ballard suggested the desirability of having the president or one of the officers of the N. E. L. A. present at every electrical meeting in the United States this year, and in closing the conference he requested that every man present write him within the next thirty days outlining his ideas as to what should be done to make this year stand out as a progressive one in the association's history.

COMMERCIAL SECTION, N. E. L. A., TO DEVELOP MEN

Arranges Organization Plans So that Latent Talent May Be Released to the Benefit of the Industry and the Individual

This year the Commercial Section of the National Electric Light Association is making an early start on its organization work. Preliminary plans contemplate that all chairmen of the standing committees will be selected in ample time to permit them to attend the executive committee meeting of the Commercial Section which will be held at Association Island on Aug. 7, 8 and 9. This method of procedure has the added advantage of coördinating the activities of the section early in the year and of injecting enthusiasm into this work.

The recommendation of Charles J. Russell that the vice-chairman and other members of committees be responsible for a portion of the work will be adopted.

The Commercial Section desires a representation in the affiliated organizations, such as the geographical sections, company sections and state electric associations, and in this way will greatly broaden its activities, primarily with the view of encouraging such associations to take an even more active interest in the commercial phases of the industry, and at the same time to bring out the latent talent which has not yet had an opportunity to participate actively in the work of the Commercial Section.

CALIFORNIA AGAIN FACES ELECTRIC POWER SHORTAGE

Unless Fall Rains Are Earlier and More Abundant than Normal, Deficiency in Supply of Energy Is Probable

Early this spring prospects were fairly good in California for a sufficient supply of hydroelectric energy. Within the last few weeks, however, the situation has materially changed, and according to H. G. Butler, power administrator of the Railroad Commission, "The power requirements can hardly be met unless rains this fall come earlier and more abundantly than they normally do."

The recent change in conditions is the result of two causes—an unusually rapid stream fall and a considerable load increase. Owing to the two preceding dry years and because last winter's snows came late, it is believed the streams have fallen more rapidly than usual and the larger steam plants of the companies have already been placed in full operation. The smaller steam plants are being put in condition to run to eapacity during the low-water period. Present indications are that the amount of power required this year will be 6 to 8 per cent greater than last year, the power administrator estimates.

Two additional sources of power will be available this year. The interconnection with the California-Oregon Power Company, completed about the first of the year, brings about 7000 hp. into the San Francisco network from northern California and Oregon, and the new 20,000-hp. steam turbine being installed by the Pacific Gas & Electric Company will be ready for operation about the middle of August. These are the only additional sources on which it is expected to draw during the low-water period.

GREATER APPRECIATION OF CENTRAL-STATION SERVICE

President McCall of Philadelphia Electric Company Calls Attention to the Opportunity to Increase Business and Insure Future Custom

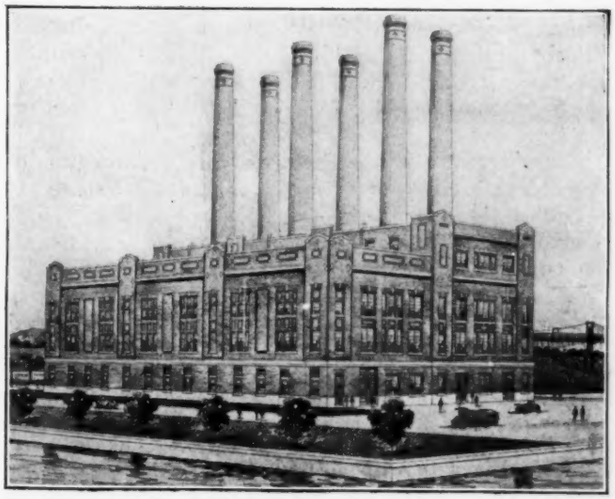
President Joseph B. McCall of the Philadelphia Electric Company, in reporting to the stockholders for the year 1918, discusses the effect of experiences during the war in serving industrial establishments.

"As a result of conditions experienced during the war period," he says, "there is much greater appreciation of the value of central-station service by the public generally, and especially by industrial establishments, many of which had to call upon us to furnish them part or all of the power required to execute their war contracts, and there never was a greater opportunity than the present for increasing our business and insuring continued future use of our service. We are adding new business as rapidly as we can, consistent with our capacity to furnish the service."

The increase in gross earnings shown for the year was due to the 10 per cent increase in rates (other than residential and municipal rates), amounting to $846,068, and to the extraordinary conditions created by the exigencies of the war, in addition to the fact that the company was not compelled by the government to discontinue service to any of the so-called non-essential industries.

The net business secured during the year 1918 was equivalent to 981,300 50-watt lamps. This increased business was principally allied with the government work and preëmpted the capacity of the system, thus preventing the company from soliciting new commercial business during the year. For this reason the net increase in the number of customers during the year was only 7095.

New 80,000-Kw. Generating Plant for Connecticut



The Eastern Connecticut Power Company's plant at Montville, Conn., is an 80,000 kw. turbo-generating station with an initial installation of 20,000 kw. It is interconnected with New England Power Company's system, forming an important tidewater steam auxiliary of the electrical supply facilities of southern New England, and is about to begin operation. The plant was designed and built by the Harry M. Hope Engineering Company of Boston, Mass.

AN EXTRA DIVIDEND IS PAID IN LIBERTY BONDS

Worcester Electric Light Company Pays $10 a Share in Liberty Bonds, and Reduces Maximum Rate for Energy from 8 to 7½ Cents

The Worcester (Mass.) Electric Light Company has distributed to stockholders of record on June 24 an extra dividend of $10 a share, payable in Liberty bonds. In anticipation of the dividend the company reduced the maximum rate for energy for lighting from 8 cents to 7½ cents per killowatt-hour on May bills. In explanation of the extra dividend, Robert W. Rollins, president of the company stated:

The Worcester Electric Light Company pays 12 per cent regular dividends. It has now declared an extra dividend of 10 per cent payable in Liberty bonds, now quoted at about 94. These dividends represent to the stockholders, not a return on the $100 par value of the stock, but on about $200 a share, which they paid for the stock. In other words, their return is 6 per cent from the regular dividend and less than 5 per cent from the Liberty bond dividend.

In connection with the extra dividend of the company, I wish to call to the attention of the public the fact that, unlike other companies in the state, no advance was made in our lighting rates during the war period, notwithstanding the increased cost of fuel and other material entering into the production cost of electricity.

In anticipation of the extra dividend paid to our stockholders in Liberty bonds, the price of electric lighting energy was reduced from 8 cents to 7½ cents on May bills. Our maximum lighting rate now is and has been for a long time past the lowest of any company in the state.

DAYLIGHT-SAVING LAW IS PROTECTED BY PRESIDENT

Vetoing Bill Which Contained Repeal of the War Measure to Change Clock Hours, He Declares Serious Economic Loss Would Result

President Wilson has personally come to the support of the advocates of retaining the daylight-saving legislation. He has vetoed the agricultural appropriation bill containing the repeal of this legislation, making public a statement in which he says that he foresees a great economic loss from such repeal. Following the action of the President, which was taken in Washington on July 12, the House of Representatives on July 14 refused by a vote of 247 to 135 to pass the agricultural appropriation bill over his veto. This refusal by the House resulted in taking from the Senate the opportunity to attempt to repass the bill. The President made the following statement public in connection with this action:

I take the liberty of returning H. R. 3157, "An act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1920," without my signature.

I realize, of course, the grave inconvenience which may arise from the postponement of the legislation at this time, but feel obliged to withhold my signature because of the clause which provides that "At and after 2 o'clock a.m. on Sunday, Oct. 26, 1919, next, the act entitled 'An act to save daylight and to provide standard time for the United States,' approved March 19, 1918, be, and the same hereby is, repealed."

I believe that the repeal of the act referred to would be of very great inconvenience to the country, and I think that I am justified in saying that it would constitute something more than an inconvenience. It would involve a serious economic loss. The act of March 19, 1918, to "save daylight" resulted not only from a careful study of industrial conditions by competent men familiar with the business operations of the country, but also from observation of the happy and beneficial consequences of similar legislation in other countries where legislation of this character has been for some time in operation and where it has resulted, as the act of March 19, 1918, has resulted in the United States, in substantial economies.

That act was intended to place the chief business activities of the country as nearly as might be within the limits of daylight throughout the year. It resulted in very great economies of energy because of the very different effect of work done in the daylight and work done by artificial light.

It, moreover, served the daily convenience of the many communities of the country in a way which gave all but universal satisfaction, and the overwhelming testimony of its value which has come to me convinces me that I should not be justified in acquiescing in its repeal.

Notwithstanding the President's veto of the legislation and the refusal of the House of Representatives to pass it over his veto, conferences are being held in Washington between members of the House and the Senate in an attempt to pass the legislation by force, under a proposed new ruling, or as new legislation or by indefinitely holding up the agricultural appropriation bill. Senators and Representatives are urged to this action by farmers. Inasmuch as President Wilson has taken a stand against the repeal of the daylight-saving law, Senators and Representatives in Congress realize that they will have difficulty in forcing the repeal. In Washington it is considered likely that Senators and Representatives are engaged in the present conference largely to convince their farmer constituents of their interest and activity.

HEARINGS AT WASHINGTON ON PATENT LEGISLATION

Consensus of Opinion of Inventors Testifying Is that There Is Need of Easier Means of Determining Money Recovery in Case of Infringement

During the public hearings before the committee on patents of the House of Representatives in Washington in the last week on three bills relating to the Patent Office, Judge Learned Hand, judge of the United States District Court, New York, pointed out what in his opinion is the need of a single court of patent appeals. Judge Hand emphasized the necessity of an increased force and better facilities in the Patent Office.

Frank J. Sprague told the committee of his personal experiences with the Patent Office and showed wherein the present facilities were inadequate. Others testifying before the committee included Dr. L. J. Baekeland, Thomas Ewing, former Commissioner of Patents; William J. Kent, United States Rubber Company; Milton Tibbetts, representing the Packard Motor Car Company and chairman of the patent committee of the National Association of Manufacturers, and Elmer A. Sperry.

Speakers scheduled for future sessions of the hearings are James T. Newton, Commissioner of Patents; Wesley G. Carr, Westinghouse Electric & Manufacturing Company; Delos Holden, representing Thomas A. Edison, and T. E. Robertson, president of the American Patent Law Association.

The consensus of opinion of inventors reciting their experiences with the present patent laws was that there was need of an easier means of determining what money recovery a patentee should have where his patent has been held to be infringed.

MANUFACTURERS OF FARM LIGHTING PLANTS UNITE

Adopt Standard Battery Ratings and Decide on Organization Plan and on Affiliation with National Gas Engine Association

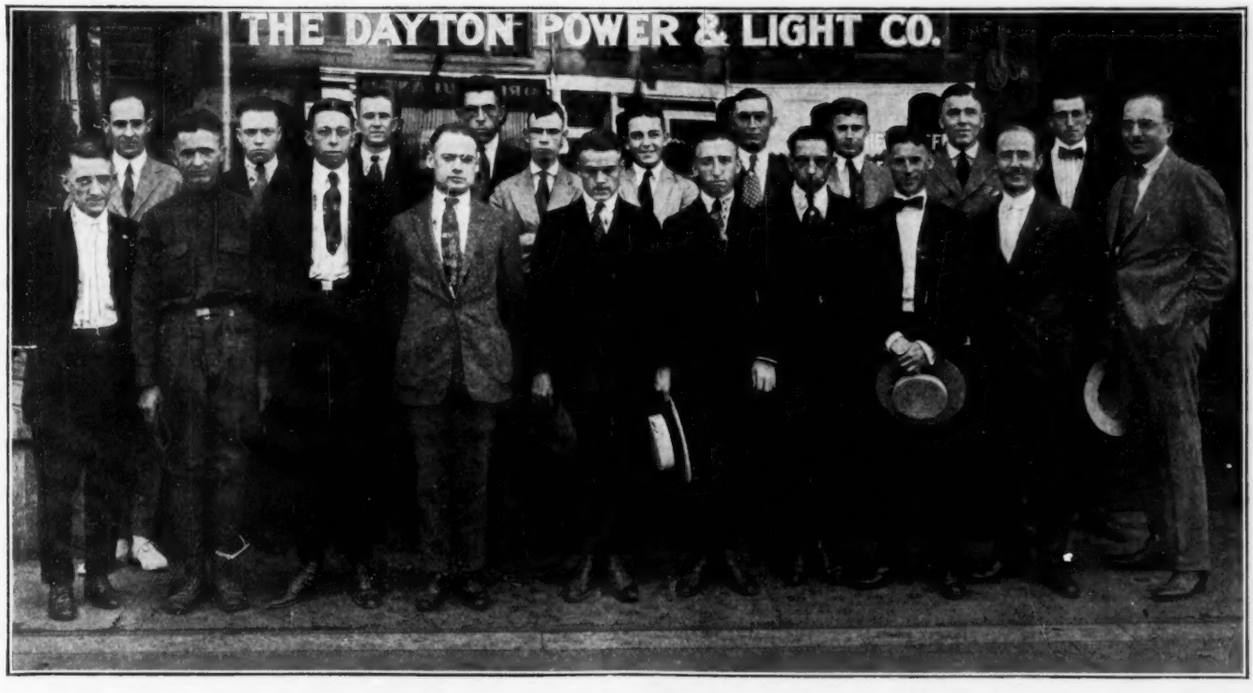
As an outgrowth of the coöperative work done by manufacturers of farm-lighting plants for the War Industrial Board, a new trade association has been formed. It is known as the Isolated Electric Plant Manufacturers' Association, and its membership is said already to include representatives of 80 per cent of the production of the farm-plant industry. The first meeting, which was of a tentative nature, occurred coincidently with the convention of the National Gas Engine Association on June 2, 3 and 4. The temporary organization formed there decided to hold another meeting at Chicago on July 10 to take up active work. At the July 10 session the thirty-three delegates who were present adopted a standard method of rating farm-plant storage batteries, settled the question of eligibility to membership and dues and appointed cmmittees to take up important work that the manufacturers feel must be done.

The standard battery rating adopted is an intermittent one based on a twenty-four-hour discharge within a seventy-two hour period. The schedule of discharge is laid out as follows: Run four hours, open circuit sixteen hours, run eight hours, open circuit sixteen hours, run eight hours, open circuit sixteen hours, and then run four hours.

Memberships of two grades are open to certain members of the National Gas Engine Association, which is regarded as the parent body. The first are manufacturers or other producers of farm-lighting plants. They are active members entitled to three votes and eligible to hold office. Their dues are $50 annually plus the fees of the parent body. The second are battery, generator and gas-engine manufacturers, who are associate members and cannot hold office but have the privilege of discussion in all meetings and are entitled to one vote. Their dues are $10 a year plus the fees of the parent association.

Something of the nature of the association's future work can be judged from the committees which were appointed. These included a committee on standard generator ratings, a committee on specifications of the Underwriters' Laboratories and on a connection with the electrical committee of the National Fire Protection Association, a committee on cleaner selling in the field, and a committee on contracts and credits of distributors and dealers. The officers of the association are: Chairman, L. F. Keilholtz, Domestic Engineering Company; vice-chairman, Fred L. Tubbs, Alamo Farm Light Company; recording secretary, G. M. Gardner, Globe Electric Company, and member industrial committee, H. M. Ballard, R. M. Owen Company. Meetings will probably be held four times a year.

Dayton Power & Light Company Opens School to Get Employees



A coöperative school was opened by the Dayton (Ohio) Power & Light Company July 1 with eighteen high-school graduates in the class. They will be given a course in electricity and then later will be trained in the different branches of the company's work to which they seem best adapted. Some will enter the sales department, where a thorough course of salesmanship will be given them. The others will take a finishing course in meter construction, testing, etc. This school is open to any high-school graduate and he is paid 30 cents an hour while attending the school. He is hired with the assurance that he will later be placed in some department of the company where his advancement will depend on his own efforts. Those finishing the course and passing an examination will be able to take a position in the department to which they show adaptability that would otherwise require training for a year or more. This school was found to be necessary by O. B. Reemelin, general superintendent of the company, on account of the rapid growth of the company and because of the shortage of young men during the last two years owing to the war.

CONTRACTOR-DEALERS IN CONVENTION AT MILWAUKEE

National Association, with Attendance of 350, Has Agreement on Plan of All Organizations to Encourage Better Merchandising Methods

With a registered attendance of approximately 350, the convention of the National Association of Electrical Contractors and Dealers opened in Milwaukee, Wis., on Wednesday of this week and continued in session until Saturday.

Monday and Tuesday were devoted to meetings of the national executive committee, at which important features of the work of the association were discussed. Chief among the topics up for consideration at the executive committee meetings was the work of the bureau of education and research, which the association will inaugurate with the help of the manufacturers, jobbers and central stations of the country. A committee of the Contractors and Dealers' Association met with representatives of the other organizations and agreed to a working plan under which the manufacturers will support the national scheme of educating the contractors and dealers throughout the country in better merchandising methods, and the other branches will support and encourage local development.

Representing the Electrical Supply Jobbers' Association were W. E. Robertson, Buffalo; N. G. Harvey, Chicago; F. E. Stow, Philadelphia; F. M. Bernardin, Kansas City, and F. Overbagh, Chicago. The central-station representatives were J. F. Gilchrist of Chicago and J. G. Learned, the chairman of the Commercial Section of the National Electric Light Association. For the manufacturing industry the committee consisted of J. J. Gibson of the Westinghouse Electric & Manufacturing Company, D. R. Bullen of the General Electric Company and A. W. Berresford of the Cutler-Hammer Manufacturing Company.

There was also considerable discussion on the labor situation, but although the meeting was marked by much free and frank discussion, nothing definite was accomplished and the work was intrusted to a subcommittee for further report to the general meeting on Friday.

The convention proper began in the auditorium with addresses of welcome by Paul C. Burrill, chairman of the Wisconsin State Association, and Cornelius Corcoran, acting Mayor of Milwaukee. W. Creighton Peet, president of the national association, made a suitable response and also rehearsed briefly the accomplishments of the association during the year. The membership, he said, had increased 35 per cent despite stagnation in the building industry. The war work committees had secured recognition for the principle of separate contracts for electrical work, and arrangements were under way for adapting the Morris plan to partial-payment schemes of merchandising apparatus and of wiring old houses. The American Institute of Architects has under consideration a plan for negotiating contracts directly with electrical contractors instead of letting electrical work to a general contractor as at present, and the coöperation of the electrical contractors is being sought in revisions to the National Electrical Code.

Mr. Peet paid a warm tribute to the trade press and urged the contractors to read the trade papers religiously if they would make the most of their opportunities.

Franz Nielson, the attorney of the association, spoke at the Wednesday morning session on coöperation in business. The Wednesday afternoon session was devoted to accounting subjects, the topics being "Keeping Up With Rising Costs," by Frank Stockdale of Chicago, and "Estimating Forms and Methods," by A. Uhl and E. S. Morely of the Estimators' Association of Chicago. A reception at the Hotel Pfister in the evening was a very pleasant affair.

The sessions on Thursday, which was virtually Goodwin day, were held at Waukesha Beach. There was a talk in the morning on general business conditions by J. H. Moss, but the main feature was a talk by W. L. Goodwin on merchandising opportunities. This was very well received. Thursday afternoon was given over to games and sports. Other features of the convention, which was still in session as the ELECTRICAL WORLD went to press, will be given in a subsequent issue.

LARGE CONVENTION OF THE OHIO ASSOCIATION

Record Attendance at This Week's Meeting at Cedar Point, with Much Interest in Labor and Other Problems of the Times—Address of Dr. McClellan

The twenty-fifth annual meeting of the Ohio Electric Light Association at Cedar Point this week was a convention in which the different features were well balanced. There were plenty of intermissions to lighten the convention routine. Manufacturers returned in greater number to show their products after an absence of four years, and the exhibitors' hall made a convenient forum for all groups to meet and discuss different conditions. There was a marked tendency for the conversation to drift around to one subject, labor. It might not have been specifically mentioned, but either the inference would be there or the thought would be back of what was said and it would come out later.

Little was said about the labor problem in the discussions at the regular sessions, but Dr. William McClellan, vice-president of the Cleveland Electric Illuminating Company, dwelt on sociological problems in his address on Wednesday morning. He compared present conditions in the country with those existing at the close of the Civil War. At that time any one who was willing to apply himself could go out and make a business success in life almost entirely by his own efforts. Now, however, organization is the order of the day and we must all depend more on others. This was emphasized in many ways during the war, from which many things have been learned.

Probably the most significant occurrence of that period as applying to future conditions of life was the draft and the exemptions which went with it. The government said where men should go, what they should do and indirectly if not directly fixed the rate of pay. Soldiers were allowed only nominal wages, while the wages of the men working to make the materials for war were boosted far above anything unskilled or skilled labor has ever received before. This put the man working with his hands into a favored class, and he naturally wants to stay in that class. Many leaders in business sacrificed wealth, position, and more besides, during the emergency, and men of standing are now being given greater recognition by the workers in consequence. Nevertheless, labor was raised to a position

of greater importance, and the laboring man wants to maintain his position now.

One of the means being used by labor to get its end is propaganda. This is an age of propaganda, when all types of individuals and groups of people are appealing to the public to support their more or less altruistic ideas for improving conditions, and Dr. McClellan advised caution in combating these ideas. He said:

"Don't antagonize such people, and remember they are not all wrong any more than we are always right. Realize that a state of flux is here; keep your eyes and ears open; keep your feet on the ground, and remember that all our progress is through evolution and not revolution. The one best thing to preach to our people now is thrift and saving. As a country we have passed out of the pioneer stage. We have used a large part of our natural wealth and now depend more and more on our savings for our wealth. When people own real estate, bonds or other property they think alike on the problems that are agitating us all to-day, but before people can own property they must save."

President I. L. Oppenheimer opened the convention with the largest registration in the experience of the association. In his presidential address he referred to the electrical developments which have taken place and to those which are coming, especially in industrial and domestic electric heating.

The paper by J. M. Strike of the Acme Power Company, Toledo, on the daily unit data and cost system was read by C. A. Lewis, Toledo, in the absence of the author.

In the discussion which followed, covering both this paper and the report of the station-operating committee, Mr. Strike was universally complimented on his success in devising an economical method of obtaining daily records of power-plant operating costs and efficiencies instead of having to wait until about the middle of the following month for the results. Among those entering into the discussion of the paper and report were C. W. Deforest, H. L. Wallace, H. W. Bromley, R. G. Sloan, G. E. Miller, C. H. Speihler, C. H. Howell, J. C. Martin, D. L. Gaskill, William Long, C. A. Lewis, S. N. Clarkson, Mr. Culver and Mr. Bailey.

The report of the committee on new-business coöperations was divided into sections on commercial lighting and merchandising, the proposed Ohio code of industrial lighting, industrial power and heating and domestic refrigeration. The last section of the report states that from present indications domestic mechanical refrigeration has passed the development stage.

Prof. C. F. Caldwell, Columbus, opened the discussion with additional information on the Ohio code of industrial lighting, which is now up to the industrial commission for acceptance. This code goes a step beyond any other code as far as is known in that it specifies the illuminating intensities required to meet the many different conditions found in each industry. The committee made plain in the code that the specified intensities were the minimum required by safety and that productive intensities many times as high are recommended.

A questionnaire was sent out by the meter committee to get the experience of different companies with meter testing. As a result of the replies which were received from nearly all over the country the committee recommended in its report that the pre-war test period of three years for small induction meters be increased to four or five years between tests. This position was supported by the discussion from the floor. The committee also outlined a course for training men for meter work. The labor turnover is so high that the companies find some such definite training plan necessary.

In discussing this subject J. T. Kermode, Cleveland, said that in most cases the small companies are not equipped to train the men and they increase the turnover of the larger companies by taking their men. Mr. Kermode thought that metermen should be paid on a basis of their replacement value instead of on a basis of what some one else is paid. He said that it would be cheaper to pay older men with the company, such as arc-light trimmers, more money to do better work than to get cheaper young fellows who leave and have to be replaced so often. Charles I. Hall of Fort Wayne, Ind., S. A. Berger of East Pittsburgh, Pa., T. L. Wright of Toledo and Charles P. Garman of Dayton also contributed to the discussion.

L. G. White, electrical expert for the Public Utilities Commission of Ohio, on being invited by the president to address the convention, said the only suggestion he had to offer was that the association appoint a committee to help the small companies to compile rate schedules. Under some of the schedules which have been presented to the commission for approval the lower the load factor of the customer the lower his rate.

Col. Ralph D. Cole, Columbus, told some of his experiences in France with the old Ohio National Guard, and William A. Durgin, Chicago, gave an address with demonstrations of the advantages of higher-intensity illumination. Both talks were well attended, and jobbers in the vicinity sent their salesmen to get the benefit of Mr. Durgin's lecture. The address by Freeman T. Eagleson of Columbus, Ohio, on the relation of utility companies to public service commissions and the other reports and addresses which were given on the last two days of the convention will be reported in the ELECTRICAL WORLD next week.

RESIGNATION OF E. N. HURLEY FROM THE SHIPPING BOARD

President Wilson Highly Commends Service During the War—Plan of Retiring Chairman to Help Small Industries Progress

Edward N. Hurley has resigned as chairman of the United States Shipping Board. His resignation has been accepted by President Wilson with expressions of gratitude and appreciation. The President wrote to Mr. Hurley:

"In more than one capacity you have served the country with distinction in these difficult times, and I am sure that you can carry away from your tasks the sense of duty well performed. No one ever served his country's interests more devotedly than did you, and personally I am deeply grateful to you. I am sure that my gratitude and appreciation are shared by all those who know the importance of the work you have done."

After a vacation Mr. Hurley will open offices in Chicago and perhaps later in New York, with other retired business men, for the purpose of advising small industries and business interests how to get the most out of their concerns. This plan has been a hobby with Mr. Hurley for a number of years. It is not proposed as a profit-making enterprise, and Mr. Hurley says he will be satisfied if expenses are paid.

LIGHTING BUSINESS SUSTAINS UTILITIES IN DULL TIMES

President-Elect S. E. Doane of the Illuminating Engineering Society Discusses National Problems Affecting the Electric Lighting Industry

The scope of the discussion at the pre-convention meeting of the illumination committee of the Ohio Electric Light Association (Prof. F. C. Caldwell chairman) in Cleveland this week extended to problems which are also confronting many other states. This was especially true of the address by S. E. Doane, chief engineer of the National Lamp Works of the General Electric Company and president-elect of the Illuminating Engineering Society.

Mr. Doane said that the lighting business is the single staple upon which the central stations have to depend, but the utilities seem to have forgotten it in their rush for power business. The power load builds up rapidly when industries are busy and drops off even more rapidly in times of business depression. That is when the lighting business is appreciated because its load curve is more nearly constant. But why wait until bad times to boost the lighting business? There has been much talk about safe intensities of illumination, whereas now is the time to preach the higher standards of productive intensities in lighting industries.

Thomas Edison sold light at sixteen candlepower-hours for one cent, but ever since the advent of meters the central stations have been getting further away from that basic idea. Mr. Doane felt that the lighting companies would profit greatly by selling light instead of energy, and the foot-candle meter is to help them to do it. A business man should be as familiar with the scale on a foot-candle meter as he is with the one on a thermometer.

Another thing the industry needs is skilled illuminating artisans or journeymen to supplement the work of the illuminating engineer as millwrights supplement the work of mechanical engineers. This will require a national educational campaign to be really effective, and the committee expects to get the active coöperation of some of the national organizations interested in this subject.

Other speakers during the meeting included H. H. Magdsick and H. T. Spaulding, who spoke respectively on "Changing Over Existing Installations" and "Approaching the Customer."

INTERCONNECTION OF NORTHWESTERN SYSTEMS

New 110,000-Volt Transmission Line Connecting Pacific Power & Light Company with Washington Water Power Company System

A new transmission line connecting the Pacific Power & Light Company with the Washington Water Power Company system has been built.

The original 60,000-volt line connecting these properties has been in operation between one and two years. It extended from Pasco to Lind, Wash., a distance of about 63 miles (100 km.). The new 110,000-volt line extends from Pasco, located on the Pacific Power & Light Company system, to Long Lake, connecting with a station of the Washington Water Power Company. It is between 90 and 100 miles (about 150 km.) in length.

URGES CHANGE OF BASE FOR ASSESSING TARIFF DUTIES

Report by Tariff Adviser of International Trade Committee Sent to Members of the Associated Manufacturers of Electrical Supplies

A report on a suggested change of base for assessing tariff duties has been sent to members of the Associated Manufacturers of Electrical Supplies. It was made by William Burgess, expert adviser to the international trade committee of the association. It outlines a "suggested change of base for assessing customs duties from the foreign market value of the foreign-made merchandise to the wholesale selling value in the United States of merchandise manufactured, produced or raised in the United States, similar or comparable to the imported merchandise, in manufacture, material, quality, grade, texture or the use for which it may be applied."

LESSONS OF THE WAR LEARNED IN ENGLAND

President Ayton of Incorporated Municipal Electrica Association Says War Taught the Nation the Importance of Electrical Supply

A survey of conditions affecting electric supply undertakings in England and a rather favorable criticism of the government electricity supply bill were features of the presidential address of Frank Ayton at the annual convention of the Incorporated Municipal Electrical Association held recently at Ipswich, England.

Mr. Ayton reviewed the recognition which the war had brought of the importance of electrical power supply and of the inefficiency of present generating and distributing methods. His remarks on these subjects follow:

The war has brought the nation to recognize, first, the importance of electrical supply, and, second, the general inefficiency and the drawbacks of the present methods of electrical generation and distribution. During the war most electric supply undertakings have been carried on under difficult conditions, including depletion of staffs, impossibility of always effecting repairs as needed, the ever-increasing demand, poor quality of fuel, shortage of plant, etc. The easing off in the output that followed the signing of the armistice came, therefore, as a rather welcome relief, but it brought at least one new difficulty, the considerable falling off in the industrial demand and the consequent diminution in revenue. This is, of course, but a temporary condition; yet the unforeseen reduction in revenue has placed a number of undertakings whose output was largely for industrial power in somewhat serious financial position.

Much has already been said about the Williamson committee's report and the government electricity supply bill. The association has put forward its criticisms of certain clauses and its recommendations for alteration and amendment. If the bill is adhered to and safeguarded, then the carrying out of its provisions will be of immense benefit to the nation, and in particular to the electric supply industry. The ultimate success of the measure will largely depend upon the choice of the electricity commissioners and the constitution of the district boards. The commissioners should be chosen solely upon their technical and business qualifications and their suitability for the positions. As for the electric supply industry, it at last will have secured its Magna Charta and have been freed from the legislative shackles which have for so many years impeded its free development.

The need for the reorganization and coördination of electric supply has been abundantly proved. The prosperity of the electric supply industry is indissolubly linked

up with that of the nation's industries. To insure that the products of the latter may compete in the markets of the world, a cheap and abundant supply of electrical power is clearly one of the main necessities. Conditions will compel the use by the manufacturer of a considerably greater amount of machinery and therefore of more power per employee than has been the case in the past. The expansion in the use of electricity during four and a half years of war is surely an index of increased demand in the future. The electric supply interests will be inexcusably lacking in foresight if they do not in good time prepare for this demand by the provision of ample generating plant.

Moreover, the development of consumption is as important to the cheapening of electricity as the building of superstations, linking up and the elimination of inefficient plants. The "business-getting" side of electric supply must be developed to a far greater extent than in the pre-war days.

LARGE IMPROVEMENTS FOR THE PITTSBURGH DISTRICT

Issue of $25,000,000 Bonds Sold Quickly—Plans for "Mouth of Mine" Generating Station with Ultimate Capacity of 300,000 Kw.

An issue of $25,000,000 first mortgage and collateral first thirty-year 6 per cent bonds has been sold by the Duquesne Light Company of Pittsburgh. The purchasing bankers, Harris, Forbes & Company; Lee, Higginson & Company, and Ladenburg, Thalmann & Company, disposed of the bonds to the public very quickly at par.

A. W. Thompson, president of the company, has given some details of the new Cheswick power plant which is to be partly financed out of the proceeds of the new issue of bonds. This plant will be located within two miles of a developed coal mine, owned by an affiliated company. The site of the plant and the mine are connected by a railroad also owned by an affiliated company.

Cheswick, where the new plant will be located, is about 13 miles (20 km.) north of the retail business center of Pittsburgh. This plant will be on the north bank of the Allegheny River and will, it is proposed, have an ultimate capacity of 300,000 kw., the present construction to be carried out with that end in view. Buildings, intake tunnels, etc., will now be constructed for a plant of 120,000 kw. capacity and a 60,000-kw., three-unit turbo-generator set will be installed initially.

An adequate water supply is available at Cheswick for the cooling and condensing requirements of a large modern steam plant. The coal mine mentioned has a present developed output capacity of approximately 1500 tons per day, which can be materially increased, and surveys indicate that the mine has a coal content of approximately 40,000,000 tons, or sufficient for more than seventy years at the present rate of output. The coal from this mine, says Mr. Thompson, is of excellent quality, with high thermal value and low ash content. Moreover, the new plant will not be dependent upon coal from this mine, as the plant will abut on the Conemaugh Division of the Pennsylvania Railroad and will be also in a position to receive coal on barges via the Allegheny River.

The entire output of electrical energy of the new Cheswick power plant will be sold at wholesale to the Duquesne company under a contract to be filed with the Public Service Commission of Pennsylvania and to extend until at least Jan. 1, 1950. In connection with the construction of this new plant, the Duquesne company will complete the construction of a 66,000-volt transmission line, with necessary substations, which will encircle the greater part of the manufacturing and business section of the Pittsburgh district and will tie in the new Cheswick power plant with the Brunot Island plant of the Duquesne company.

The properties operated by the company and its subsidiaries form a single interconnecting system which serves a total population estimated to exceed 1,100,000, in the heart of the Pittsburgh district.

TRADE COMMISSION FAVORS RESALE PRICE MAINTENANCE

Federal Body in Special Report to Congress Renew Recommendation that Manufacturers Be Permitted to Fix and Maintain Resale Prices

The Federal Trade Commission in a special report to Congress renewed its recommendation made last December that manufacturers be permitted by law to fix and maintain resale prices, subject to review by a disinterested agency.

The commission says that such a law would remove present complexity in the business world, promote the efficiency of manufacturing and commercial institutions and serve the interest of the consuming public.

Under the commission recommendation, manufacturers desiring to fix and maintain resale prices would file with an agency to be designated by Congress descriptions of their articles, contracts of sale and the price schedules to be maintained. The disinterested agency would be charged with the duty, "upon complaint of any dealer or consumer or other party at interest," to review the terms of contracts and prices.

The commission's recommendations, it stated, were based on the following conclusions:

(1) That producers of identified goods should be protected in their intangible property right or good-will, created through years of fair dealing and of sustained quality of merchandise.

(2) That the unlimited power both to fix and to enforce and maintain resale prices may not be made lawful with safety.

(3) That unrestrained price-cutting is not in the public interest, and tends, in the long run, to impair, if not to destroy, the production and distribution of articles desirable to the public.

TRADE BARS AGAINST GERMANY ARE LOWERED

So-Called "Blanket Licenses" to Be Issued by State Department, but Exceptions Are Made in Dyes, Chemicals and Potash

The State Department has announced that trade bars between the United States and Germany will be lowered. This will be accomplished by means of a so-called "blanket license," which will enable American firms to do business at once with Germany and which will likewise permit German firms to get goods from the United States. No question of repealing the trading-with-the-enemy act is involved. The blanket license recognizes the technical state of war between the two countries but gives licenses to trade despite this situation. Special licenses for particular commodities will not be required, as the blanket license is expected to cover all trade.

Exceptions are made, however, in the matter of German imports of dyes, chemicals and potash as protection for American industries is desired.

State and Riparian Rights in Water Storage Basins.—Justices of the Maine Supreme Court in a reply to questions propounded by the State Legislature have outlined the rights of the State in water powers and storage basins. The questions and abstracts of the answers are as follows:

"Question No. 1. May the Legislature authorize the construction and development by the state of water storage reservoirs and basins for the purpose of controlling and conserving the waters of the public lakes and great ponds, of increasing and regulating the flow of rivers flowing therefrom, and of increasing the value and capacity of the water powers of said rivers?"

ANSWER

"If the last clause were omitted we might have answered this question in the affirmative, as it might be conceded that the improvement of our rivers for the purpose of improving naturally navigable or floatable waters, and thereby floating the products of the farm and of the forests to market, would be a matter within the constitutional power of the Legislature. It would be the improvement of waterways for transportation and therefore would be akin to the promotion of railroads, which are no more than improved highways.

"If, however, this clause is intended as the paramount purpose to which the preceding clauses are but introductory, and the real question in the minds of the members of your honorable body is whether the state may develop storage reservoirs for conserving the waters of the great ponds and increasing and regulating the flow of the outlet rivers and streams for the chief purpose of increasing the capacity and value of the privately owned water powers on said rivers and streams, whether developed or undeveloped, then we must answer this question in the negative."

References were made to many cases in rendering the opinion on this point.

"Question No. 2. In the case the construction and development of water storage reservoirs and basins as aforesaid is held to be legal may the state charge to the owners of water powers located on rivers below such storage reservoirs and basins a proportional part of the cost of such construction and development, or in lieu thereof a sum in the nature of a rental or tax, based upon the increased power thereby made available for use of said water-power owners?"

ANSWER

"As an answer to this question is only desired in case the former question were answered in the affirmative, the justices infer that no further answer need be made. Since however we have indicated, although apparently that inquiry was not in the contemplation of your honorable body, that the state might create storage reservoirs for conserving the waters of great ponds and regulating the flow for the purpose of increasing the navigability of the outlet rivers and streams, the question might arise under No. 2 whether in such cases any tax or rental might be based upon the increased power thereby made available at the various mill sites. We must answer that we know of no such tax that could be assessed on the increased capacity, except an increased tax on the enhanced value of the dam site. That would be in violation of the constitutional provision requiring all taxes assessed by authority of the state to be apportioned and assessed equally according to the just value thereof."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

"Question No. 3. When the Legislature has granted a private corporation the right to erect a dam to control the waters of a public lake or great pond without raising the natural high-water level thereof, in order that the waters therein may be impounded and used for purposes of such corporation, may the Legislature subsequently impose a tax upon such corporation based upon the increased amount and use of water from said lake or pond which the corporation enjoys by reason of having erected such dam?"

"Question No. 4. Where the Legislature has granted a private corporation the right to erect a dam to control and also to raise the natural level of waters of a public lake or great pond in order to impound additional waters to be used for the purposes of such corporation, may the Legislature impose a tax upon such corporation based upon the increased amount and use of water from said lake or pond which the corporation enjoys by reason of having erected such dam and of having raised the natural level of the waters of said lake or pond?"

ANSWER

"These questions involve the same principles and can be answered together. In regard to No. 3 the question assumes the erection of a dam to control the waters of a great pond without raising the natural high-water level. Even under those conditions, rights of flowage must be acquired, because every littoral proprietor, owning as he does the shore to low-water mark, is entitled to his land between high and low water mark in its natural state. No person or corporation would have any more right to flow land that, in a state of nature, would at any season of the year remain uncovered than to flow land above the high-water mark. Either act requires authority from the Legislature, general or special. Question four assumes the maintenance of flowage between high and low water and also above the natural high-water level. The same principles are therefore involved in both questions, although the damage would be greater in the one case than in the other.

"These two questions, it will be observed, are complete in themselves and independent of interrogatories one and two. The purpose for which the waters are to be impounded and the flow regulated and increased, whether public or private, is not divulged. The exercise of the power of eminent domain does not enter into the proposition. The single question is the right of the state to impose a tax upon a private corporation chartered for the purposes indicated, based upon the increased amount and use of water from a great pond which the corporation enjoys by reason of having erected such dam.

"Evidently the corporation could not be taxed separately for the use of the water as property, because water power as a separate entity is not taxable. The corporation can be taxed only upon the 'just value' of its property however acquired and whatever may be its elements of value.

"Nor can the dam itself with its appurtenant rights be subject to a special property tax. That would violate the constitutional provision requiring equality of apportionment and assessment before referred to.

"We see no reason, however, why the Legislature may not have the constitutional power, if it is deemed expedient to exercise it, to put into one class all corporations having express grants from the Legislature to control the waters of great ponds, and impose a tax upon the franchises of such corporations, that is, upon the right to carry on their corporate business and to exercise their granted powers. Taxes of this kind are now imposed upon railroad, express, telephone and telegraph companies and savings banks. The power of the state to impose franchise taxes seems to be plenary, and it may not only impose them, but it may measure their amount by any standard it sees fit to adopt.

"With these qualifications and explanations we return a negative answer to questions number three and four on the assumption of the assessment of a property tax, and an affirmative answer on assumption of the imposition of a franchise tax, leaving the legal rights of the parties in concrete cases to be determined by the developed facts."

Establishment of Municipal Electric Light Plant.—The Court of Appeals of Kentucky has held that the necessity of having an electric light system is not so great as to create an "emergency" within the constitutional provision prohibiting creation of indebtedness beyond 3 per cent except in such a case, and an indebtedness in excess of said 3 per cent could not be incurred for a water system and lighting plant jointly, though there was an emergency as to the water system (211 S. W. 567).

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Examination for Electrical Assistant in Signal Service.—The United States Civil Service Commission will hold a competitive examination on Aug. 19 for the position of electrical assistant to fill a vacancy in the Signal Service at large, War Department, for duty at Manila, Philippine Islands, and future vacancies requiring similar qualifications. The salary ranges from $1,500 to $2,000 a year.

Control of Coal Prices.—A bill introduced in the House of Representatives by Representative Huddleston of Alabama provides for the continuation of government control over coal and coke prices four years after the war. The bill is designed "to provide further for national security and defense by encouraging production and distribution of fuel and to prevent sale thereof at excessive prices and conspiracies relating thereto." It states that "by reason of the recent existence of a state of war it is essential for the national security and defense and for restoration of peace and order to insure adequate supply of fuel and equitable distribution and sale thereof at reasonable prices and to facilitate movement of fuel and to prevent scarcity, monopolization and control affecting supply, distribution and movement thereof." Penalties are provided for violation of orders which may be issued by the President fixing maximum prices.

Surplus of Labor.—Telegraphic reports received by the United States Employment Service for the week ended July 5 from eighty cities throughout the United States show an aggregate surplus of labor amounting to 177,392, as compared with a surplus shown by ninety-six cities last week of 211,290. In making public the summary of the reports, John B. Densmore, director general of the United States Employment Service, announced that it would be the last, owing to the inability of the service to bear the expense of gathering the information. Of the eighty cities included in the telegraphic reports, thirty-eight report the above surplus, sixteen report a shortage of 23,980, while twenty-six report an equality. The above figures indicate that while the surplus of labor is about unchanged the shortage has shown a rather material increase. The reports indicate that of the thirty-eight states reporting twenty have reported surplus of labor, nineteen an equality and eight shortage. In some instances shortages and surpluses in different lines of work are noted.

New School for Carnegie Institute.—The Carnegie Institute of Technology, Pittsburgh, Pa., has announced the establishment of a school of industrial engineering which the institute is undertaking jointly with the United States Bureau of Mines and coal operators of the Pittsburgh district.

Will Confer on Consumers' Deposits—The New York Public Service Commission, Second District, has asked the Empire State Gas and Electric Association to appoint a committee to confer with the commission on the entire subject of consumers' deposits. H. L. Mann, J. C. De Long and H. O. Palmer have been appointed as the association's representatives. Among the matters to be taken up are proposed segregation of deposits and methods of paying interest on deposits.

American Gas & Electric Stock for Employees.—In declaring dividends recently the directors of the American Gas & Electric Company announced a special dividend of 2½ per cent on the common stock, payable in common stock. This was declared to make it possible for the company to have common stock for sale to employees. Stockholders are asked to sell back to the company at par the shares which they are entitled to receive under this special dividend.

McGraw-Hill Book Company Ten Years Old.—The history of the McGraw-Hill Book Company as a publisher of technical and industrial books is sketched in a booklet which the company has published to commemorate the first ten years of its existence. The company was formed July 1, 1909, by union of the book departments of the McGraw Publishing Company and the Hill Publishing Company. The total number of volumes sold in the first year of the business was 72,927, while the volumes sold in the tenth year totaled 654,635. The average number of new books, including fully revised editions, has been a trifle over a book a week for the entire period of ten years. A section of the booklet deals with the activities of the company during the war. Under special contracts with the Navy Department the company edited and produced the texts for the aviation and submarine sections of the navy—fully twenty in all. With the coöperation of the Committee on Industrial Preparedness and the Council of National Defense, numerous books on munitions manufacture were produced. There were, besides, special texts on aviation, aircraft mechanics, radio work, shipbuilding and various branches of military field engineering, many of which were officially adopted. In 1918, when the machine shops of the country were running at full capacity, 40,000 copies of Colvin and Stanley's American Machinist's Handbook were sold. There are besides in process numerous books that will cover fully the technical development during the war not only of the United States but of other countries as well in airplanes, marine engineering, the gasoline engine, military explosives, etc.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Rate Comparisons Not Controlling.—In denying a petition for reduction in the hot-water-heating rates of the Merchants' Heat & Light Company, Indianapolis, the Indiana Public Service Commission criticised the practice of comparing rates. On this point it said: "Testimony introduced by petitioners is that at two points in Indiana and Wisconsin, lying north of Indianapolis and subject to longer winters and more severe weather conditions, rates are materially lower than respondent's rates for like service. Comparisons of rates for like service in other cities may or may not be of value, but in no case are such comparisons controlling. Each rate consideration is governed by conditions that are individual to it. Petitioners did not present for comparison rates higher than are charged in Indianapolis, both in this state and Wisconsin, whose reasonableness, under the unprecedented conditions existing, has not been challenged."

Commission Rules on Change from Alternating Current to Direct Current.—A recent case before the Illinois Commission in which J. T. Livingston complained concerning the practice of the Central Illinois Public Service Company in changing electric appliances at Royalton, when the plant was changed from direct-current to alternating-current operation, brought forth a decision which is of particular interest to companies which are connecting direct-current plants to alternating-current systems. The order authorized the company to change to alternating current, and directed that it should exchange all lamps, flatirons and fans owned by consumers that were rendered useless by the change free of charge. The order also directed that the company should offer to each consumer having direct-current appliances not applicable to alternating-current service an exchange proposition for these appliances as follows: "Payment shall be made at the full present value of the equipment. Present value shall be determined thus: Take cost, new (estimated or agreed upon in event there is no existing record of actual cost), and deduct therefrom the salvage value, to derive the service value. Ascertain the number of years which the equipment has been in service and estimate the future conful life of the equipment. Per cent condition will be the ratio of the remaining years of useful life to the total (past plus estimated future) life of the equipment. To the scrap value add the service value multiplied by the per cent condition, in order to derive the present value thereof."

Prof. A. P. Little, formerly of the Bureau of Standards, who went to the Sheffield Scientific School of Yale University last year in connection with the Signal Corps training school for officer candidates, has been appointed professor of electrical engineering in the Colorado School of Mines.

E. Burt Fenton, formerly publicity manager of W. S. Barstow & Company, and for the past two years in charge of similar work for the Northern Ohio Traction & Light Company, with headquarters at Akron, Ohio, has resigned his position with the latter company. His future plans have not as yet been announced. Mr. Fenton has for a number of years specialized on matters pertaining to the public relations of utilities and is probably best known as author of "Snuggling Up to John Smith" and "The Missing Link," papers which have attracted favorable comment among central stations.

Gordon Campbell, president and general manager of the Edison Light & Power Company of York, Pa., has been reëlected president of the Pennsylvania Street Railway Association. Mr. Campbell has been identified with the management of the activities of the association since December, 1916, first as a member of the executive committee, then as vice-president and as president since June, 1918. Before going to York, Pa., in 1908, he was associated with public utilities in Denver, Col., Newark, N. J., Providence, R. I., and Washington, D. C. Mr. Campbell is also president and general manager of the York (Pa.) Railways.

G. Francis Gray, who has been in charge of radio development work being done for the government by various manufacturers in commercial laboratories and known as the outside development branch of the Office of the Chief Signal Officers, is now associated with the engineering department of the National Aniline & Chemical Company, New York City. Mr. Gray was commissioned a captain in the Signal Corps a year and a half ago and has directed the work of various manufacturers in developing special radio apparatus, such as air fans, high-frequency generators, storage-battery charging plants and airplane radio accessories.

Rear Admiral Robert S. Griffin, engineer-in-chief of the United States Navy, has had conferred upon him the honorary degree of doctor of engineering by the Stevens Institute of Technology. Admiral Griffin since 1913 has been chief of the Bureau of Steam Engineering, which covers motive power of all naval vessels, including electrical machinery, radio-telegraph and machinery for naval aircraft. He has been a strong advocate of electric propulsion of battleships, and it was under his supervision that the installation of electric drive on the battleship New Mexico was carried out and the interned German ships rehabilitated. He was born in 1857 and graduated from Annapolis in 1878.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Bejamin P. George, the newly elected president of the National Electrical Credit Association, has been the Chicago representative on the national board of the association for the past five years. Born in Concord, N. H., in 1862, Mr. George graduated from Dartmouth College in the class of 1884, and ever since that time practically all of his activities have been along credit or financial lines. He was interested in credit matters for fifteen years before he became closely connected with the electrical industry as credit man for the Beardslee Chandelier & Manufacturing Company in 1908. Mr. George is still responsible for the credit policy of that company, although he has had the additional responsibility of being its treasurer since 1917.

BENJAMIN P. GEORGE

Dr. W. R. Whitney, director of the Research Laboratory of the General Electric Company, Schenectady, N. Y., received the honorary degree of doctor of chemistry from the University of Pittsburgh on June 13. This honor was conferred upon Dr. Whitney in recognition of the valuable service which he rendered to the government as a member of the Naval Consulting Board. The degree was given upon the recommendation of the Mellon Institute of Industrial Research, an integral part of the University of Pittsburgh.

Prof. Ira W. Fisk, who was connected with the electrical engineering department of the University of Illinois for nine years and has been professor of mechanical and electrical engineering at Drexel Institute, Philadelphia, during the past year, has resigned to join the staff of John A. Beeler, consulting engineer, of New York City.

Ell C. Bennett of St. Louis, Mo., has resigned office as the seventeenth Mercury of the Jovian Order, to which post he was elected last October, to serve until January, 1920, to join the International Paint Corporation in the capacity of secretary and general manager.

R. W. Owens, who was graduated with the degree of electrical engineer from the University of Illinois in 1914 and with the degree of M.S. in 1915, has been placed in charge of the industrial engineering department of the Westinghouse Electric & Manufacturing Company, following the resignation of Albert Brunt, who has returned to Holland. Mr. Owens entered the employ of the Westinghouse Electric & Manufacturing Company as an apprentice and shortly afterward was assigned to the industrial engineering department in the direct-current design section.

Obituary

Oscar Otto, general superintendent of the Essington Works of the Westinghouse Electric & Manufacturing Company at Essington, Pa., recently died from injuries received in an automobile accident. Mr. Otto, who was about sixty years old, had a responsible part in the construction of the plant at Essington and had been general superintendent of the works ever since.

George R. Webb, a financier who had been connected with many Pennsylvania public utilities companies, died July 7 at his home in Baltimore, Md. Mr. Webb was sixty years old. His activities in the public utility field included the organization of the Maryland Telephone Company, the Pittsburgh & Allegheny Telephone Company, the Wilmington Light & Power Company and the Duquesne Light Company of Pittsburgh. At a later period, with Pierre S. du Pont and Harry P. Scott, he consolidated the street railways and light and telephone system of Wilmington under the name of the Wilmington & Philadelphia Traction Company.

Baron Rayleigh (J. W. Strutt), a prominent physicist of Great Britain, died June 30 in London. Baron Rayleigh was born Nov. 12, 1842, and educated at Trinity College, Cambridge. From 1879 to 1884 he was Cavendish professor of experimental physics in Cambridge University, and in 1887 he accepted the post of professor of natural philosophy at the Royal Institution of Great Britain. He was awarded the Nobel prize for physics in 1904, and in 1908 he was elected chancellor of Cambridge University. Baron Rayleigh is best known for his work in chemical physics, theory of gases, flow of liquids, etc., and in electric and magnetic problems.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

DECIDED UPWARD TENDENCY IN PRICES NOW EVIDENT

Fast Approaching Limit, Which, According to Present Indications, Will Be Reached During the Coming Fall Months

Within the last two months the question of when prices are coming down has given way to the question of how much higher prices are going. After the armistice prices generally receded from the high war level. In the last two months, however, prices have tightened and a very decided upward trend is noticed.

In the building line lumber, stone and certain of the hardware items are up. Steel and pipe are no higher, and while there are possibilities of both staying at present levels, an advance at almost any time would not be surprising.

Copper has now reached the 22-cent mark from a low post-war price of 14½ cents. Copper wire as a result has taken a 7-cent advance. All copper and brass products, such as sheets, rods and tubes, are higher. These are used largely in electrical products, and higher prices in the lines using them most may be expected to follow quickly.

Cotton, also used in large quantities in electrical products, has advanced tremendously and at the present writing is quoted on the exchange at over 35 cents a pound, with a decided upward tendency.

An interesting market situation is consequently fast developing. There is a limit to which prices can go, beyond which a heavy reaction will set in. Just what this limit is and when it will be reached is of course a matter of speculation. On copper, for instance, one authority sees 25 cents before the fall. On cotton there are plenty who predict 40 cents or more.

On top of raw materials cost comes labor, which is getting more costly with great rapidity. Just at present buying of all kinds is growing. Construction work is increasing and the number of jobs on drawing boards is getting to be very large. Some of these jobs, however, are being held up because of the present prices. Furthermore, prices are so high now that advancing prices can hardly be expected to stimulate building.

It seems certain now that this fall will see the peak of prices, and that after that a gradual decline can be expected. Whether this peak will come early or late will depend largely on the rapidity with which prices advance in the meantime.

ARGENTINE REPUBLIC AS A MARKET FOR WIRE AND CABLE

Trade Gained During War Cannot Be Held Permanently by American Producers, According to Government Agents

Good grades of wire are having a growing field in Argentina. About one-third of the republic's electrical imports are wire and cable. Prior to the war American manufacturers enjoyed but a small part of this trade. Since the summer of 1914, however, it has increased considerably; but, according to reports from P. S. Smith, special agent of the Bureau of Foreign and Domestic Commerce, American wire cannot expect to hold this war trade permanently.

To get the Argentine market American manufacturers, the report states, must be able to supply a good grade of wire at a cent or two cheaper than competitors. Foreign-controlled utilities and foreign consulting engineers, of course, specify as a rule the wire made by their own nationals. Next to the demand from large users comes that for house wiring. About one-half of this wire is imported. It is pointed out that this wire should be in metric sizes, and if not the coils should be marked with both the metric and B. & S. gage numbers.

Considerable quantities of twisted cord are used in Argentina, but of a type which is rather more flexible than the American standard. The insulation is poor, but the price is low and the customers seem to be satisfied. German, Italian and Japanese wire furnish competition with American wire.

Standard round and grooved trolley wire is used, and the report states that sales should be very good once prices are normal.

Insulated overhead feeders have not proved satisfactory because the atmosphere contains such a large percentage of saline moisture.

There is a small demand for a good grade of high-tension and armored automobile cable for ignition circuits.

Armature and magnet wire is used by all the lighting and street-railway companies for repairs.

Local manufacturers of annunciator and other cotton-covered wires are buying the bare copper and cotton in the United States and putting it together locally.

Some figures showing American exports of insulated wire and cable to Argentina since the war began are interesting. For the last five fiscal years ended June 30 the values have been as follows: 1914, $12,490; 1915, $83,678; 1916, $140,146; 1917, $222,318; 1918, $203,164. For the first four months of the current year the exports have been: January, $71,997; February, $27,080; March, $94,445; April, $6,048—a total of $199,570. In making comparisons, however, the varying copper base must be taken into account. Thus 1918 exports in volume of wire were greater than 1917 exports, although the values were lower because of the lower copper base.

NEW PACKING METHOD FOR INCANDESCENT LAMPS

It Will Not Go Into General Practice Immediately Because of the Large Stock of Old Packing That Remains on Hand

A new style of package for "mazda" incandescent lamps has been devised to meet the requirements of safety of contents, effectiveness of display, neatness and cleanliness, economy of space, convenient handling of individual lamps, and to provide for reshipping small groups of lamps.

At the present time the only lamps coming through in this new carton are the type C-4, known as the "white mazda" lamp. The lamp companies still have heavy stocks of present cartons and material to use up before it can be expected that they will universally adopt the new packing.

Under the new arrangement each lamp is provided with an individual wrapper, and the lamps are then packed in trays designed to hold a certain number of a given size. No provisions are made in the present plan for continuing the old five-lamp-carton merchandising plan.

Except for depth the trays for the various sizes of lamps have the same dimensions, thus making it possible to make up a standard package of different sizes of lamps.

No excelsior is used in the new packing, the cushioning of the lamps being the only shock absorber. Tests made both at the factory and at the University of Wisconsin

have shown a smaller percentage of breakage for the new style packing than with the old style.

Incidentally the new standard package is smaller in size. Consequently it is much more economical of warehouse space.

Standard-package quantities are as folllows:

10, 15, 25 watts	S-17	bulb	120
23, 25, 36, 40, 50 watts	S-19	bulb	100
60 watts	S-21	bulb	64
15, 25 watts	G-18½	bulb	100
15, 25, 40 watts	G-25	bulb	64
50 watts	PS-20	bulb	80
75 watts	PS-22	bulb	64

FLASHLIGHT GUARANTEE ABUSES TO BE WATCHED

Possibility that Manufacturers Will Keep Dealers' Stock Down to One Month's Requirements to Remedy Trouble

Flashlight guarantees are being given consideration by manufacturers, as has been reported before in these columns. At the same time, however, manufacturers are fully aware of the abuses that may occur unless some restrictive measures are employed.

For instance, one manufacturer found an excessive number of flashlight batteries returned periodically by one dealer. Upon investigation it was disclosed that when a refill was purchased the old battery was thrown on the floor and that frequently the store sweeper, thinking these old batteries were good ones, put them back on the shelves with the new stock.

There are many other abuses, one of which is that of overstocking. Cases are known where stock remained on shelves for a year with no apparent special effort to move it because dealers knew that they could return depreciated stock. It would not be surprising if the manufacturers decided to keep each dealer's stock down to as much as he can dispose of within a month.

DUTCH EAST INDIES PROVIDE GROWING ELECTRICAL MARKET

From a Previous Total of Around $2,000 These Islands Took a Total of $675,380 of American Electrical Goods in First Four Months of 1919

Attention is directed to the accompanying table showing the exports of electrical goods of American manufacture to the Dutch East Indies. As a market for American products this Dutch colony is becoming very important. For instance, in the fiscal year ended June 30, 1913, the exports of American-made electrical merchandise to the Dutch East Indies were $1,961; in the fiscal year 1914, $1,288; in 1915, $50,177; 1916, $162,653; 1917, $379,186, and in the last fiscal year $214,851. For the first four months of the current calendar year the total is $675,380.

In other words, prior to the outbreak of the war in 1914 this market was served almost entirely by Dutch bottoms which received their electrical freight from Germany. With this supply cut off the demand for American goods grew. So far as bottoms and goods were available simultaneously this market was in a manner taken care of. When the war restrictions were removed the true size of this market became more apparent.

The islands profited greatly by the war. Oil, tin, rubber and sugar brought unheard-of prices. As a result there is lots of money there to be spent and the inclination seems to be to spend it.

Already there are a number of electrifications under way or projected. Orders are being placed in the United States for large quantities of electrical materials.

At the rate for the first few months of the calendar year 1919, electrical exports to this market should reach $2,000,000. Present indications are, however, that they will be even greater.

ELECTRICAL EXPORTS TO DUTCH EAST INDIES

	Fiscal Years						First Four Months
	1913	1914	1915	1916	1917	1918	1919
Batteries	.....	.....	.....	.....	.....	$13,442	$57,736
Carbons	.....	.....	.....	.....	.....	11,843	12,806
Generators	.....	.....	.....	$5,294	$10,749	6,974	41,543
Fans	.....	.....	$16	698	1,175	459	9,246
Heating and cooking apparatus	.....	.....	.....	.....	.....	48	728
Insulated wire and cable	.....	.....	16,224	79,873	206,586	50,386	104,553
Interior wiring supplies, including fixtures	.....	.....	65	369	1,325	5,080	4,437
Arc lamps	.....	$95	.....	.....	.....	.....	.....
Carbon filament lamps	.....	.....	.....	2	.....	.....	589
Metal filament lamps	.....	.....	6	380	2,280	5,388	66,950
Magnetos, spark plugs, etc	.....	.....	.....	.....	.....	23,897	44,721
Meters and measuring instruments	.....	.....	25	2,461	3,158	569	10,375
Motors	.....	158	12,529	9,126	9,052	4,359	77,192
Rheostats and controller	.....	.....	.....	.....	.....	40	2,493
Switches and accessories	.....	.....	.....	.....	.....	17,239	19,986
Telegraph apparatus, including wireless	.....	.....	.....	.....	2,680	34,975	5,346
Telephones	$385	.....	135	3,135	28,508	6,672	37,189
Transformers	.....	.....	.....	256	15,009	1,655	29,361
All other	1,576	1,035	21,177	61,059	98,664	31,825	150,029
Total	$1,961	$1,288	$50,177	$162,653	$379,186	$214,851	$675,380

EXPANDED STEEL POLES ARE IN DEMAND ABROAD

Electrification Projects in Foreign Countries Offer Good Market for American Product Even in War Time

While domestic sales of expanded steel poles for transmission and distribution lines have been good, demand during the war from foreign countries for electrification projects is especially interesting.

Among the first foreign purchasers were the Swedish State Railways, which bought poles for the famous Kiruna-Riksgränsen line—the only electrification within the Arctic Circle. The results on that line have been so satisfactory that the Norwegian State Railways have made the same pole standard for the forthcoming 45-mile electrification between Christiania and Drammen. From Italy, at the other extreme of Europe, the demand became so insistent that an Italian company, Societa Anomina Italiana Expansione Ferro Bates, has been organized, with headquarters at 2 Salita del Carmine, Genoa. The machinery for this company has already been shipped. Negotiations are now under way for the formation of a British company.

Still more remarkable are the war-time shipments to such remote spots as Johannesburg, South Africa; Bombay, India; Soerabaya, Java; Perth, West Australia; Adelaide, South Australia; Sydney, New South Wales, and Hobart, Tasmania.

SATISFACTORY CREDIT SITUATION IN THE EAST

Jobbers' Collections Have Become Closer to Thirty Days Through More Strict Adherence to Credit Rulings than Formerly

Strict adherence to the thirty-day credit ruling is keeping collections among New York City jobbers in extremely good condition. There is a type of jobber, however, who is less careful of his credit system, and an order is an order with a chance taken on payment within a reasonable time. That type of jobber is gradually coming to realize the importance of stricter credits, and the reflection on the whole industry of laxness in extending credit and following up slow payments with the ultimate cutting off of the habitual offender.

Some small contractors in the East are asking larger credits, to the extent of about a 25 per cent increase, and where circumstances seem to justify they are getting it. But the whole jobbers' credit situation is in better shape than earlier in the year through more inclination to hold customers to strict accountability.

Collections from large contractors around New York are good, while many small ones cannot carry their overhead and pay for material on a job until that money comes in. Central stations and industrials in this vicinity are on the list of satisfactory collections. The better class of dealers is satisfactory, but at this time some of the smaller dealers are asking longer credits on account of fan sales.

Trade acceptances are coming into better favor with jobbers and manufacturers alike. Some discount and realize immediately, while others hold to maturity, with no apparent predominance of either policy. These are being used more extensively for good accounts as well as for the poorer ones. The Morris plan of payment is being used more extensively in the sale of large socket devices.

METAL MARKET SITUATION

Copper Selling at 22.25 Cents in Active Market—Lead, Zinc and Brass Climb Further

Copper continues merrily on its way upward with a rise of 2⅜ cents over last week. Quotations for July, August and September are held at 22.25 cents, with sellers hesitating on booking beyond September.. Consumers are more inclined to purchase for future delivery with the apprehension in their minds of the unfavorable labor situation in Montana. Strikes in this territory can have a serious effect on the already curtailed copper production, with resultant lower production and an upward tendency of prices. Producers are reticent about the disposal of large amounts of their stocks because they feel that higher prices are coming.

The London market has continued upward to £105 for a rise of about £10. These increases in London spot prices are bringing the metal to a point where the exportation of copper from America offers considerable attraction to sellers.

One of the more favorable turns in the market was the announcement of the sale of the entire government stocks of copper. These stocks amounted to about 100,000,000 lb. of metal instead of the assumed 140,000,000 lb.

Copper and brass products are up over 2 cents, and still further advances are expected with copper increases.

Lead has gone up another $2 per ton to 5.50 cents in New York. Consuming demand is good and much interest is shown in future deliveries.

Spelter, too, finds itself on the upward path this week. July shipment is quoted at 8.05 cents to 8.15 cents a pound for New York. Better buying of zinc is noticed for the brass industry.

NEW YORK METAL MARKET PRICES

	July 9	July 16
Copper:	£ s d	£ s d
London, standard spot	95 5 0	105 0 0
	Cents per Pound	Cents per Pound
Prime Lake	20.25	2.25 to 22.75
Electrolytic	19.87½	22.25
Casting	19.25	21.75
Wire base	21.75 to 22.00	24.50
Lead, trust price	5.[illegible]0	5.50
Antimony	8.37½	8.62½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	7.45	8.05 to 8.15
Tin	70.50	70.50
Aluminum, 98 to 99 per cent	32.00 to 33.00	32.00 to 33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.00 to 16.75	17.00 to 18.00
Brass, heavy	8.75 to 9.75	10.00 to 10.50
Brass, light	8.25 to 8.50	9.00 to 9.25
Lead, heavy	4.75 to 4.87	4.75 to 4.87
Zinc, old scrap	5.00 to 5.25	5.00 to 5.52

THE WEEK
IN TRADE

SALES east of the Rockies are still increasing, but on the Pacific Coast, except for appliances and fractional-horsepower motors, conditions are if anything quieter. In California a special discount has been arranged for larger purchases of carbon lamps.

Fractional-horsepower motors are in very large demand everywhere and sales of power motors up to 500 hp. are rapidly increasing. Fan sales to consumers have received a temporary halt, owing to cooler weather. Local stocks are being fast replenished. Fixture demand is making rapid strides. In the South prices are up and rural districts are furnishing most of the sales. Wire sales are still growing and in some districts, especially the South and Middle West, shortages of weatherproof are developing. Sales of code wire for the week ended July 10 are estimated at $550,000, and of No. 14 rubber-covered at $340,000.

Prices are tending upward. Wire is higher, with 26 cents as the probable rubber-covered base before the close of the week. Silk floss has forced silk-covered wire up.

Collections are generally in good shape. Utilities are taking somewhat longer, however, to pay obligations.

Deliveries are getting longer, and with the approaching heavy harvest demand from the West no betterment of this situation can be expected for some time.

Labor conditions are more unstable than they have been for some time and appear to be getting worse. This condition seems to come in waves.

NEW YORK

The jobbing market presents nothing of interest this week beyond maintenance of a pretty fair buying movement in most material. The fan market is spotty. Large motors are selling better, with particular application to increased activity in the silk, rubber and textile industries. Copper in its rise is carrying wire upward in weekly price advances. Cotton is higher, and advances may be expected in products embracing cotton. Cotton and silk insulating materials are already up. Silk-covered wires have advanced on account of an increased price set on silk floss.

Labor conditions in some brass factories have improved, but in the Rome district serious outbreaks have occurred in wire and brass mills.

MOTORS.—An increasing market for motors for printing-press work is found in this district. Orders for large-size motors of 100-hp. and 200-hp. capacity are in better volume. Some of the applications are for compressors and pumps.

WIRE.—Manufacturers of rubber-covered wire have increased bases. One is on 27 cents, four on 26, one on 25, two on 24, two on 22 cents and one on cost. One manufacturer expects 26 cents to hold as a base very soon. Bare wire is quoted on a 24 to 25-cent base, and weatherproof on a 24 to 26-cent base. Silk-covered cord and magnet wire has been reported higher by 10 per cent in one case, and in another case even higher than that with no figure given. Costs of silk floss are responsible. No. 14 duplex wire is having better sales.

CONDUIT FITTINGS.—During the last three weeks the amount of industrial reconstruction and recircuiting work has opened up a market for conduit fittings for exposed work, so that buying has increased.

FANS.—Some of the jobbers report that the cool days of the past week have slowed up to a considerable extent the fan sales. One of the larger distributers, however, reports the market in good condition.

LAMPS.—Sales in general are better than expected for the summer months.

CONTROL.—Inactivity in steel-mill electrical installation and construction is holding back remote and automatic control in this industry, but reports show that things are getting ready to go ahead. There is better buying of alternating-current push-button control for certain types of woodworking machinery up to about 5 hp.

REFLECTORS.—The National X-ray Reflector Company announces the addition of 10 per cent to list prices on "scoopettes" and "hoodettes," including fittings, parts and equipment, as of July 1. Indirect lighting lists were advanced from 30 to 44 per cent, depending on material. New dealers' discounts amount to 33⅓ per cent.

CABLE.—Nice-sized orders for power cables have recently come in. These are well distributed throughout the country, but in particular have shown up better in the Eastern market.

CHICAGO

Labor troubles are increasing. Building was held up by bricklayers' and laborers' strikes, and after they were settled the carpenters walked out. The surface and elevated car men have threatened to strike unless their pay is increased 77 per cent. Contracts let for buildings in the Central Western States during the first half of this year are valued at over 60 per cent in excess of the average figures for the same period of the five previous years. The new building projects announced in Chicago last week included two hotels, to cost a total of about $2,500,000. Of the 129 building permits granted last week 109 were for residences and small apartments. A seven-story building to cost not less than $1,000,000 is to be erected in St. Louis to house the Fur Association. The American State Bank of Omaha, Neb., plans to build a twenty-story building. A number of industrial buildings and a million-dollar apartment house are also to be erected in the same city. The labor surplus in this part of the country is smaller than at any time since the beginning of the year, and from present indications there will be a serious shortage within the next six months.

COPPER WIRE.—Locally prices are more or less arbitrary. A base rate varying from 24 cents to 26¼ cents per pound is being charged for bare and weatherproof wire, while 25 cents to 26 cents is being asked for rubber-covered. Some jobbers have been able to replenish their stocks but have little or no stock, especially of weatherproof. Factory deliveries are so slow that those who have the wire do not expect to keep it long. Nos. 6, 8 and 10 weatherproof are almost at a premium, and the demand for rubber-covered also is being strongly maintained.

MOTORS.—Motors of from 50 hp. to 500 hp. are being sold in increasing numbers and in increased sizes to industrial plants. One manufacturer sold four 500-hp. motors in Chicago last week to industrial plants. Deliveries are about on a pre-war basis.

TURBO-GENERATORS.—There is a steady demand in sizes up to about 3000 kw. for industrial plants. The same is true of 5000-kw. sets to replace old and less efficient units in utility power houses and for extensions. Machines rated at 20,000 kw. can be obtained in about eight months, and units below 10,000 kw. in six months or less.

CREDITS AND COLLECTIONS.—As a class the telephone companies all appear to have money, and their credit is very good. With few individual exceptions, however, the credit of the other electric utilities is very poor and in some cases even worse than during the war. Collections are generally good but very slow from telephone utilities. Telephone collections average about sixty days. Collections of central-station and traction accounts are nearer six months. These customers ask for ninety days in the first place, and more often than not ask for an extension of another sixty to ninety days at the end of the first period. Some few of these utilities give trade acceptances, but a greater number settle their accounts with notes. The railroads are very slow.

LINE MATERIAL.—The steady demand is being maintained with no change in price. In some quarters, however, prices are expected to stiffen.

FANS.—The last week has been comparatively cool, and the fan situation did not change materially. The 12-in. and 16-in. oscillating fans continue to sell best, though there are still jobbers who have fair stocks on hand. Some of those who are out of the oscillating types are able to fill large orders for the non-oscillating sizes. There has been a heavy demand for the 32-volt fans, but there are still some good stocks to draw from.

BOSTON

Trade holds up well, and jobbers' salesmen from the field report an optimistic feeling among buyers. One representative jobber remarked a few days ago that practically all his customers are fairly busy with plenty of work in sight, the only thing holding them back appearing to be the labor shortage, which is now rather acute in some localities. All signs point to a heavy fall business, and buying is directed toward this end. Collections are holding up fairly well, although some fluctuations are noted in promptness of payment. Stocks are being rapidly built up in most lines. Deliveries are still reasonably good in nearly every line, although a tendency toward longer deliveries is apparent in commodities in very heavy demand. The building trade appears to be more active and many jobs are being handled. Prices are still maintained on a very firm basis, with upward tendencies in wire. Some talk is heard of a possible advance on sockets, but this had not materialized at the end of last week, so far as could be learned.

WIRE.—Practically all manufacturers are now selling rubber-covered wire on the 24-cent base. A good deal of wire is now being handled, but no shortage of magnitude is in evidence.

STREET-LIGHTING FIXTURES.—Trade is rather spotty, the present cost of labor and material being in some cases a deterrent upon expansion of local lighting facilities. It is safe to say that the demand is at least equal to the pre-war volume. Prices are steady, with little prospect of change at present.

MOTORS.—Business is good in the smaller sizes. Inquiries are in very healthy volume, and orders are coming in well. Betterment work in the power field in industrial plants is occupying much attention just now. Some single-phase motor prices rose 10 per cent July 1, but this represents in part at least a return from a previous recession, according to reliable opinion. Factory stocks in some makes are running low in the smaller sizes of motors.

GENERATORS AND TRANSFORMERS.—Many inquiries are being handled by district offices and a fair number of small orders are being received. Industrial plants are asking for bids, but are a little slow in closing. Textile mills are coming into the market at present, and the government is again listed among the larger buyers.

INDUSTRIAL ELECTRIC TRUCKS.—A fair demand is noted, with steady prices. The feeling in this branch of the trade is better than a few weeks ago. Not all makers have advanced prices as yet to cover recent battery price increases.

FANS.—Stocks are in reasonably good shape. The recent wave of extreme heat did not reduce all jobbers' stocks as much as might have been expected, because retailers stocked up heavily during the previous wave. Shipments are coming in rapidly.

APPLIANCES.—Washers, cleaners and irons are moving fast. Grills are selling well. Ranges are moving nicely, 114 being sold in two weeks in a recent drive of the Hartford (Conn.) Electric Light Company.

FIXTURES.—The larger houses still have substantial stocks. The demand is increasing and prices are in the main unchanged.

ARMORED FLEXIBLE CONDUIT.—Deliveries are reported to be improving.

RIGID IRON CONDUIT.—Although a shortage is predicted in some circles, the supply is still equal to the demand among some houses.

SECOND-HAND ELECTRICAL MACHINERY.—The demand for used equipment is below past levels. Trade in motors up to 10-hp. rating is strong at present. Single-phase motors are hard to get.

ATLANTA

The number of building permits and values covering construction in the Southeastern States continues to grow each week. Permits at Atlanta for the first six months of this year show an increase of 55 per cent over the same period in 1918. The value per permit is 30 per cent in excess of 1918. While quite a few industrial centers were slow in starting construction, present activity along this line points to a swelling volume for the last half of 1919. As a consequence of building operations wiring contractors are doing a nice business.

FIXTURES.—The volume of sales is growing. A big business is being done in shower fixtures from rural sections. The city demand calls for direct and semi-indirect types. Basis brass advanced 2 cents this week. This, together with the sky-rocketing of general prices and an increase to labor of 22 per cent by the manufacturers, is reflected in an increase by jobbers in the Southeast anywhere from 15 to 30 per cent. And the end is not yet. Jobbers fully expect glassware to jump 50 per cent shortly. Shipments on ordinary fixtures are getting worse, and it is almost impossible to get off-standard goods.

STARTING STORAGE BATTERIES.—Orders are coming in freely, and this item appears to be running on its own momentum. Shipments are good and local stocks are normal.

NON-METALLIC CONDUIT.—While this class of conduit is not so active as the metal products, a fairly satisfactory trade is observed.

POLES.—The demand for all lengths is excellent, and incoming shipments on Western cedars are keeping stocks filled up. An increasing call for chestnut is noted. Prices advanced 10 per cent this week.

INSULATORS.—A small change in price is noted this week to jobbers, but no difference to dealers is observed. Requirements from central stations appear to be growing and a corresponding stimulation in sales is noted. Local stocks are well filled and factory shipments are prompt. The demand for procelain insulators is still off with prices remaining steady. Factory deliveries are promised for two weeks.

CROSS-ARMS.—The market is quite active even in the face of a 10 per cent advance this week. Stocks are ample.

HARDWARE.—Southeastern stocks have reached a normal condition due to better factory shipments and the fact that the market is comparatively slow.

WIRE AND CABLE.—The call for heavy cables is somewhat dull, but the market for 300,000-circ. mil. and 500,000-circ. mil. sizes is active. Weatherproof base has advanced to 25 cents and rubber-covered to 24 cents. Jobbers report difficulty in receiving Northern shipments on account of labor trouble at the factories. A few jobbers report a serious shortage of weatherproof.

RANGES.—Dealers and central stations report little activity. Indications are that this product is not being pushed so extensively as it was this time last year. Stocks throughout the Southeast are well balanced.

LAMP CORD.—Prices have been withdrawn this week. Deliveries are up in the air on account of labor difficulties at factories. Orders are taken and priced as date of shipment.

SEATTLE—PORTLAND

The month of July to date shows no particular increase in sales, although not long ago both jobbers and dealers in Seattle predicted that July would lead preceding months by a considerable margin. If anything, jobbers' sales to shipyards and industrials during the past two weeks have decreased. It is reported unofficially to-day that a foreign government has offered one or more Seattle shipbuilding companies contracts for several steel ships, and negotiations are proceeding, with time of delivery the determining factor. Retail sales along domestic appliance lines show no decrease. Washing machines and vacuum cleaners lead the movement, closely followed by electric irons and electric tableware. Housewiring devices also show steady movement, although the increase predicted for midsummer has not materialized. One large retailer reports a deal pending for a considerable number of electric ranges for a new apartment house.

Prices, with the exception of copper wire, remain firm. Copper wire has registered several small increases lately and is still tending upward. Stocks in all lines, generally speaking, are in excellent condition and replacements are being made without any considerable effort. The existing coast-wide telephone strike, while not a complete tie-up by any means, is having its effect. Collections are in excellent condition and credits show no change.

The Portland district reports that in all sections of Oregon there is an unusual activity in household appliances, particularly washing machines, mangles, ranges, percolators and other electric tableware. This activity in household appliances keeps up general business, offsetting the slack sales of motors and other larger apparatus, which have shown no particular movement for some time. General business in manufacturing and jobbing lines seems to be about the same as usual. In the retail line it is nearly double what it was a year ago. There is a decided upward tendency in copper prices. otherwise there is very little change. It is reported that an understanding is rapidly being reached between officials representing local shipyards and the Emergency Fleet Corporation, which promises to put two and probably three Portland steel shipyards on a very substantial construction basis for a long period.

SCHEDULE MATERIAL.—In Seattle jobbers report a slight improvement in sales. Stocks are sufficient and replacements are being made easily.

MOTORS.—Fractional-horsepower sizes during the past week showed a slight temporary increase in demand. Small industrial sizes have a fair demand but not so great as to prevent gradual building up of stocks. The sale of larger motors and heavy power apparatus is virtually at a standstill, with the exception of scattering orders from lumber companies which are electrifying plants gradually. Stocks of larger size motors are reported as ample.

SAN FRANCISCO

Bumper crops are reported from all over the state, the crops of apricots, green fruit and melons being especially fine. The freight service from the East, so essential to Western industries, has decreased in quality, probably running about a third poorer in the number of days taken in transit from the time noted during April and May, which was almost normal. Labor conditions are again tense. The telephone strike, affecting operators and linemen, is now in its fifth week. It is reported that linemen employed by the power companies are now refusing to do any work upon joint poles, which may affect other branches of the electrical industry. Sales in general have slumped slightly because of summer conditions. Retail sales have dropped.

LAMPS.—The local lamp factory is running again after its annual seasonal shutdown, during the course of which no appreciable pinching of supplies was felt by the dealers. In general business is quiet and there are no large jobs in sight as there were last year. The labor condition at the shipyards is another thing which has greatly popularized the use of carbon lamps and necessitated the offer of a $500 net, six-month-period, quantity price on these lamps. This is a decrease of about 20 per cent from the standard-package quantity and makes a net price of $13.70 per 100 for the standard 60-watt carbon lamp f.o.b. coast.

WEATHERPROOF WIRE.—Prices, which are climbing steadily for the base sizes, are now $28 per 100 lb. in coil lots, with few and scattered sales reported.

RUBBER-COVERED WIRE.—The circular-mil sizes have advanced about 2½ per cent, but the house-wiring sizes have remained steady.

SMALL MOTORS.—There is unprecedented demand for fractional-horsepower sizes, and many of the inquiries are from manufacturers who propose to use these small motors in their product.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

Armored Conductor, Flexible Steel

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%

Twin-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft.	5%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft.	5%

Twin-Conductor

	No. 14 Solid
Less than coil	$100.00
Coil to 1000 ft.	82.50
	No. 12 Solid
Less than coil	List
Coil to 1000 ft.	5%

Attachment Plugs

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20% to list
1/5 to std. pkg.	List to 20%
Std. pkg.	23% to 36%

Batteries, Dry

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.40	.40
50 to barrel	.36	.37
Barrel lots	.329	.339

Batteries, Dry—*Continued*

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.362	.372
Barrel lots	.332	.342

Conduit, Metallic Flexible

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
⅝	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00 to 109.00	93.00 to 95.00

Conduit, Non-Metallic Flexible

Size, In.	List per Foot	Size, In.	List per Foot
⅜	$0.05½	1	$0.25
½	.06	1¼	.33
⅝	.09	1½	.40
¾	.12	1¾	.47
⅞	.15	2	.55
1	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$30.00	$22.00	$21.00
½-in.—	35.00	24.00	23.00

NET PER 1000 FT.—CHICAGO

	Less than 250 ft.	250 to 2500 ft.	2500 to 10,000 ft.
⅜-in.—	$33.00–$42.00	$17.50–21.00	$16.25–19.00
½-in.—	36.00– 45.00	19.00–22.75	17.75–21.25

Conduit, Couplings and Elbows, Rigid Iron

Card No. 40

Size, In.	Conduit, List per Foot
⅛	$0.08½
¼	.08½
⅜	.08½
½	.11½
¾	.17
1	.23
1¼	.27½
1½	.37½
2	.58½
2½	.76½
3	

Conduit, Couplings and Elbows, Rigid Iron—*Continued*

Size, In.	Couplings, List	Elbows, List
⅛	$0.05	$0.19
¼	.06	.19
⅜	.07	.19
½	.10	.25
¾	.13	.37
1	.17	.45
1¼	.21	.50
1½	.28	1.10
2	.40	1.80
2½	.60	4.80
3		

DISCOUNT—NEW YORK

	⅛ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	4% to 12.1%	6% to 14.1%
2500 to 5000 lb.	9% to 15.1%	11% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	⅛ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3% to 6.1%	2% to 8.1%
2500 to 5000 lb.	+1% to 11.1%	4% to 13.1%

(For galvanized deduct six points from above discounts.)

Flatirons

NEW YORK

List price	$6.50 to $7.50
Discount	25%

CHICAGO

List price	$6.50 to $7.50
Discount	25% to 30%

Fuses, Inclosed

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	40%

Fuse Plugs

3-Amp. to 30-Amp

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$6.00 to $8.75
1/5 to std. pkg.	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$8.00
1/5 to std. pkg.	7.00

Standard packages, 500. List each, $0.07

Lamps, Mazda or Tungsten

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

Lamp Cord

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$26.47–$35.01
Coil to 1000 ft	23.82– 29.17

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$21.00–$31.00
Coil to 1000 ft.	21.00– 22.00

Lamp Guards, Wire

Standard packages from 50 to 150

NEW YORK

Net per 100	$29.70 to $33.00

CHICAGO

Net per 100	$29.70 to $33.00

Outlet Boxes

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	33%–40%	24%–32%
$10.00 to $50.00 list	45%–50%	32%–43%

Pipe Fittings

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

Porcelain Cleats—Unglazed

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$15.00 to $22.40
1/5 to std. pkg	12.00 to 15.35
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$17.85–$24.15
1/5 to std. pkg	14.70– 21.00
Standard pkg., 2200. List per 1000.	$20.00 to 21.00

Porcelain Knobs

NEW YORK

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.60–$15.00	$22.00–$22.40
1/5 to std. pkg	10.50– 11.20	15.35– 18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg.	$13.60–$18.40	$27.20–$36.80
1/5 to std. pkg	11.20– 16.00	22.40– 32.00

Sockets and Receptacles

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20 to list
1/5 std. pkg	List to 10%

Switches, Knife

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-qmp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	20%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%
$10 to $25 list	+10%
$25 to $50 list	+5%
	Low Grade
Less than $10 list	+15%
$10 to $25 list	20%
$25 to $50 list	5%

Switches, Snap and Flush

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

Switches, Snap and Flush—*Continued*

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	25%

Switch Boxes, Sectional Conduit

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%–20%	List–18%
$2.00 to $10.00 list	28%–30%	5%–28%
$10.00 to $50.00 list	45%–50%	10%–47%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	30% to 33%	24% to 25%
$2.00 to $10.00 list	30% to 33%	24% to 25%
$10.00 to $50.00 list	30% to 45%	25% to 36%

Toasters, Upright

NEW YORK

List price	$6.00 to $7.00
Discount	25%

CHICAGO

List price	$7.00
Discount	25% to 30%

Wire, Annunciator

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.47
No. 18, full spools	.46

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.4571 to $0.50
No. 18, full spools	.4075 to .445

Wire, Rubber-Covered, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$15.00	$14.00	$ 9.50
12	19.62	19.62	14.72
10	26.64	26.64	17.76
8	36.72	30.60	24.48
6	58.14	48.45	38.76

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.50	$10.00	$10.00
12	22.05	22.05	18.90
10	29.68	29.08	25.44
8	40.39	34.62	34.62
6	63.84	54.72	54.72

Wire, Weatherproof

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$29.00
25 to 50 lb	28.00
50 to 100 lb	28.00

CHICAGO

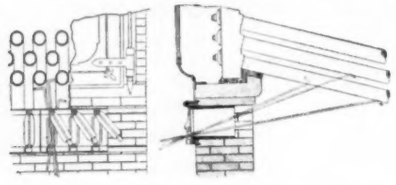
	Per 100 Lb. Net
Less than 25 lb	$27.75
25 to 50 lb	27.75
50 to 100 lb	27.75

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Boiler-Tube Scraping Device

Boilers equipped with the tube scraping device just brought out by the Combustion Engineering Corporation, 11 Broadway, New York City, can be kept free from accumulation of cinders without interfering with the operation of the boiler. The device provides openings in the front or rear wall of



FRONT AND SIDE VIEWS OF BOXES, SHOWING POSITION OF SCRAPPERS IN USE

a boiler setting through which a lightweight hook can be inserted and used to scrape the cinder and ash from the bottom and sides of the lowest row of boiler tubes upon which the coke or ash adheres.

Tube-scraping door castings, bottom-tube-scraping doors, tube cleaning or scraping wall boxes and access doors for tube scraping compose the device. The boxes are made in sections of three, four and five doors, which are spaced the same distance apart as the tubes of the boiler in which they are installed. Two or more sections are bolted along the top and bottom sides, providing one opening or door for each space between the tubes. The openings are not in line with the tubes but halfway between them, and therefore the sides as well as the bottoms of the tubes may be reached, and also the bottom of the second row of tubes. When installed, the brickwork is laid so that the boxes are protected from radiant heat and, being in short sections, 21 to 35 in. (53 to 89 cm.) long, they will not warp and twist and loosen the brickwork above and below.

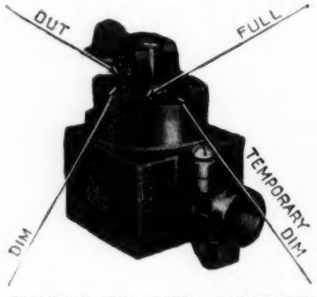
Extension Lamp with Strong Cord

Especially suitable for "knock-about" garage use is said to be the "Duracord" portable electric extension lamp, just placed on the market by the Tubular Woven Fabric Company of Pawtucket, R. I. The cord with which this lamp is equipped is not braided, but is woven from thick heavy strand and, according to the maker, its texture is so tough that the cord can be pulled around corners, over sharp projections, dragged through oil and water, and even walked upon without stretching or raveling and with no more injury than ordinary wear and tear.

The 20 ft. (6 m.) cord of the extension lamp is held in the handle by a fitting which is said to take all strain from the terminals and to prevent the wires from pulling loose. A strong metal guard protects the lamp bulb and a hook is provided for hanging. Three styles of the lamp, all completely wired, can be obtained.

Dust-Proof Searchlight Lamp Switch

A self-contained, dust-tight searchlight lamp switch developed for locomotive use that will effectively replace a double-throw switch for dim and full light and a momentary



HANDLE HAS FOUR POSITIONS

contact switch for temporary dim light has been recently brought out by the Crouse-Hinds Company of Syracuse, N. Y. In operating this switch the handle goes from the "off" position to the "dim" light position with an easy push, and another slight push brings it into "full." A longer life for the lamp is insured by the switch having to go into the "dim" position before it can reach the "full" light position, because in so doing the filament of the bulb is given a chance to heat before coming to its highest incandescence.

There are two "dim" positions in the switch—a temporary and a permanent. When passing another locomotive the switch handle can be pushed from the "full" to the "temporary dim" position and held there until the other train has been passed. Upon the handle being released the switch automatically snaps back into "full" light. In passing through train yards or other places where brilliant headlights are inadvisable, a slight lift of the handle brings the switch from "full" to the "permanent dim" position.

The switch is compact, the maker points out, and can be mounted anywhere to insure convenience. The mechanism is such that it cannot get out of order and the internal spring and the stops on the switch cover insure proper location of the switch at the positions desired and make it impossible for the switch to stop between positions.

Luminous Switch Indicator

Two forms of the "Radium Glo-Ball" luminous indicators, distributed by L. Plaut & Company, 432 East Twenty-third Street, New York City, are available. The pendent style has a wire ring and prongs of spring steel for attaching to electric light chains, etc. The star form of the luminous indicator is backed with an adhesive and can be stuck on switch plates or on woodwork and walls without marring them.

Double Adjustable Desk and Table Lamp

What is called a double adjustable desk and table lamp will be placed on the market next month by the Retherford Brothers Company of Muncie, Ind., and will be known as type No. 8690. It is double adjustable in that a hinge joint is provided so that the lamp socket can be raised or lowered at will and, in addition, the shade

SOCKET CAN BE RAISED OR LOWERED AND SHADE SWIVELS

swivels, to give further adjustment to the rays of light.

Statuary bronze, verde, green and pompeian bronze are the finishes in which the lamp will be procurable. All finishes are dark, enabling them to withstand, without appreciable loss of attractiveness, the handling and hard knocks of every day use.

Lighting Plant with Sleeve-Valve Engine

A Willys-Knight sleeve-valve engine is used in the electric light and power plant which will shortly be manufactured by the Electric Auto-Lite Corporation of Toledo, Ohio, and distributed by its Willys light division. The complete plant comprises the motor or engine, which burns kerosene, a direct-connected generator, a storage battery and a simple control box. The plant is air-cooled, self-cranking and self-stopping, the control being semi-automatic.

In place of noisy poppet valves, the maker says, are two cylindrical sleeves, one within the other, which glide silently up and down between the piston and the cylinder wall. The long ports in these sleeves register with each other and with the ports in the cylinder wall at the proper intervals, forming large direct passages for the intake and exhaust gases. Instead of decreasing its efficiency carbon is said to increase the efficiency of the engine.

The generator used in the plant is wound for 32 volts and delivers 750 watts. The armature of the generator, the engine flywheel and crank shaft are constructed in practically one piece, eliminating separate generator bearings and reducing friction. The storage battery has sixteen cells with nine plates to the cell. The cells are inclosed in sealed glass jars and have a capacity of 160 amp.-hr.

Unusual Type of Electric Vehicle Drive

A radical change in motor construction and in the method of transmitting the power developed to the place of utilization has been incorporated in the electric vehicle recently brought out by Harry E. Dey, 303 Arlington Avenue,

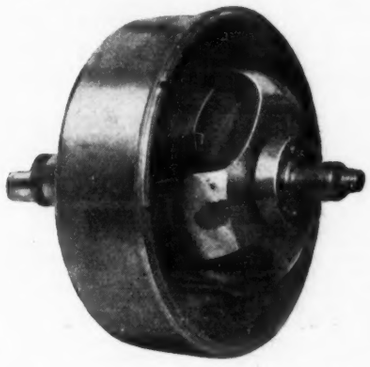


FIG. 1—SIX INTERPOSED FIELD POLES ARE ENERGIZED BY ONE COIL

Jersey City, N. J. As shown by the accompanying drawing, both the field and armature revolve, one element driving one wheel and the other element the other wheel through peculiar yet simple gear mechanisms that afford speed reduction and also correct the direction of rotation. Because of the arrangement used no differential gear is required (the motor elements acting as such), the motor can be mounted in line with the hubs, and a small, relatively high-speed motor can be employed because the motor elements rotate at relatively high speed but effectively at only half speed. The field poles, which are six in number, are interposed as shown in Fig. 2, alternate ones being connected together to an axial core which is magnetized by one coil. The armature is very similar to an alternating-current motor stator (that is, with teeth projecting inward), but it has a face-type commutator and rotates. The face of the commutator, which is a conical surface, is inclined 10 deg. to a plane perpendicular to the shaft in order to avoid the increased friction of the brushes which would be caused by centrifugal force.

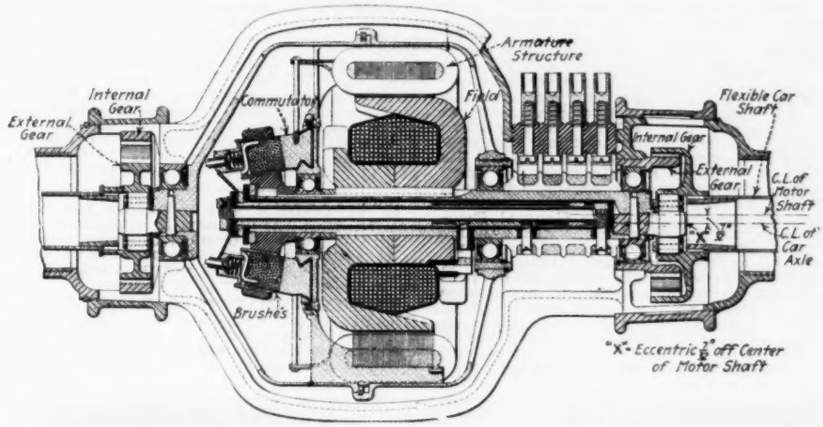


FIG. 2—ARMATURE AND FIELD OF MOTOR ROTATE IN OPPOSITE DIRECTIONS, EACH DRIVING A REAR WHEEL THROUGH GEARS

To the outer end of each motor shaft is fixed an eccentric with $\frac{3}{32}$-in. (4.5-mm.) throw. The field-shaft eccentric is surrounded by a roller bearing which carries an internal gear. Meshing with this is an external gear which is concentric with the motor shaft but keyed fast to the stationary house. The internal gear is connected by means of a flexible shaft to the wheel hub. At the armature-shaft end the construction differs only in that the external gear is mounted on the eccentric while the internal gear is keyed to the house. When the internal gear is the rotating element, as at the field-shaft end, the direction of rotation remains unchanged between the motor and wheels, but with the external gear as the rotating member, as at the armature end, the direction is reversed.

For speed variation of the vehicle on which this motor is used a foot lever is employed that is so connected that with the foot removed the car runs at full normal speed. A slight pressure inserts resistance, producing the equivalent to slipping the clutch on a gasoline-driven machine. As the pressure is increased resistance is added until finally the current is completely shut off. Further movement converts the motor into an electric brake, and an extreme movement applies the mechanical brake. An accelerator pedal, acting upon the field, increases the speed to thirty or more miles per hour (48 km.).

On down grades the motor recharges the battery and the car speed automatically slows down as the grade becomes steeper, thus making the driving unusually safe. An increase of speed may be obtained at any time, however, by means of the accelerator.

The vehicle is equipped with a gasoline engine which drives the charging dynamo for the batteries. This can be operated either when the vehicle is running or when it is stopped. When the battery is fully charged the engine will be automatically cut off. The battery is carried beneath the floor, attached to the truss rod posts. It is not absolutely necessary that the charging outfit be carried on the machine; in fact, it can be installed at home for farm-lighting or other uses.

NOTES ON RECENT APPLIANCES

Lighting Fixtures

Chain-hung and ceiling-type lighting fixtures known as "Rite-Lites" are now made by the King Manufacturing Company of St. Joseph, Mo.

Plug and Receptacle for Marine Use

Watertight plugs and receptacles for marine use are now manufactured by the Horne Manufacturing Company, 2 College Place, Brooklyn, N. Y.

Fractional-Horsepower Motors

The Wald Electric Manufacturing Company, 417 Canal Street, New York City, has placed on the market a line of direct-current motors in capacities of 1/10 hp. to ¼ hp.

Electric Massage Vibrator

The Shelton "Special" electrically driven massage vibrator has been placed on the market by the Shelton Electric Company, 30 East Forty-second Street, New York City.

Manufacturers' Activities

G. E. ACQUIRES TRUMBULL INTEREST.—The General Electric Company made the following statement this week: "The General Electric Company has acquired an interest in the Trumbull Electric Manufacturing Company of Plainville, Conn. The present management of the Trumbull Electric Manufacturing Company still retains a financial interest in the company and will continue in active charge of its manufacturing and selling policy. The Trumbull Electric Manufacturing Company has an enviable reputation, national in its scope, as a large manufacturer of knife switches and safety-first iron-box inclosed switches, as well as a general line of miscellaneous supplies, and the General Electric Company, believing in the great future of the safety-first movement, feels that an alliance between these two leading manufacturers of goods designed to promote the safety-first feature in service entrance switches, motor control devices, etc., will give considerable satisfaction, not only to the present customers of the Trumbull company, whose name will remain unchanged, but to the trade in general."

C. E. OGDEN will terminate his connection with the Automatic Electrical Devices Company, Cincinnati, Ohio, on August 1, retaining, however, the position of consulting engineer. The company expects to be in its new factory soon.

THE INTERNATIONAL RADIO TELEGRAPH COMPANY, 326 Broadway, New York City, when it moved its factory from the Bush Terminal Building in Brooklyn to the Tower Building at 326 Broadway, in-

GENERATING EQUIPMENT SECTION OF INTERNATIONAL RADIO TELEGRAPH COMPANY'S PLANT

HOT POINT SUFFERS $150,000 FIRE LOSS.—Fire practically destroyed the storage house of the Hot Point Division of the Edison Electric Appliance Company on Ogden Avenue, Chicago, July 6. The loss, which included a large quantity of unfinished stock, will run up to about $150,000. According to a statement from the company the damage inflicted will lengthen deliveries by only two or three days.

EMERGENCY FLEET CORPORATION TO DISPOSE OF SURPLUS AND SALVAGE PROPERTY BY PUBLIC SALE.—The U. S. Shipping Board Emergency Fleet Corporation has arranged for the sale of its surplus and salvage property. Upon the sale list is electrical machinery. All sales will be consummated either by open bidding on advertised items or from price lists made up after careful study of existing market conditions and approved by the Sales Review Board. To prevent speculation, every effort will be made to confine sales to those who, it is believed, have actual use for the property offered. But where the sales manifestly will cause no disturbance of general market conditions, they may be made even though it be known that the items are being obtained for resale. The corporation will coöperate closely with the other government departments and the Chamber of Commerce of the United States, in ascertaining market conditions, and wherever it appears that the unloading of a large quantity of any particular product will unduly disturb the regular trade channels or react unfairly upon particular industries, steps will be taken to limit sales and to distribute them over such periods as will most satisfactorily permit of absorption of the surplus stocks and material on hand without embarrassment to any interest concerned. Proposed sales by the corporation will be advertised widely in the daily newspapers of the principal cities of the country.

creased its floor space about 150 per cent, to 25,000 sq.ft. The company occupies the entire fifth floor and devotes its manufacturing space exclusively to radio-telegraph and radio-telephone work. S. E. Adair, formerly of the Western Electric Company, is chief engineer, and Howard W. Dunk is commercial manager. The company manufactures the wireless-telegraph sending sets which were used by the NC boats in the transatlantic flight. These sets, the manufacturers state, are capable of interplane communication up to 700 miles, and to 1400 miles from plane to shore. The company is standardizing two sets for aircraft of 200-watt and 550-watt capacity. The photograph is of that part of the shop where the generating equipment as used on the "Nancys" is manufactured.

THE DUBILIER CONDENSER COMPANY, INC., 217 Centre Street, New York City, announces that it has changed its factory from war to peace production and is now making mica condensers especially for line and machine protection from high-frequency surges and lightning discharges. At present it is experimenting with condensers for power-factor correction. This problem has been given serious consideration by its London company, which is now experimenting with a 2-kw. plant at its works, with satisfactory results.

ROY E. SCHAULIN, formerly New York district manager of the Franklin Lamp Company, has been appointed assistant to the president of the Russell & Stoll Company, New York City, manufacturer of marine and vapor-proof electrical fittings.

BUSH ELECTRIC COMPANY, formerly the Bush Electric Tool & Manufacturing Works, Redlands, Cal., has moved to 6654 Broadway, Cleveland, Ohio. The reorganized company expects to start production shortly. H. B. Bush is in charge of the factory.

E. M. ZINSMEYER, after nineteen years of continuous service, has resigned his position as sales and advertising manager of the Frank Adam Electric Company, to become associated with the Martin Wright Electric Company, electrical contractors and dealers, San Antonio, Tex.

MANNING, BOWMAN & COMPANY, manufacturers of electric tableware, Meriden, Conn., have announced the adoption of a fifty-hour working week, instead of fifty-five hours, with wage adustments upward, but "so long as business conditions warrant it the working hours will remain fifty-five hours per week as at present."

B. G. TARKINGTON, who has been employed in the aircraft division of the United States Army and who prior to that time was in charge of power sales for the Consumers' Power Company of Michigan, has joined the staff of the Sanborn Electric Company, Indianapolis, Ind., as manager of the farm-lighting department.

THE EDISON STORAGE BATTERY COMPANY announces the removal of its district office in Pittsburgh, Pa., to Room 431, Union Arcade Building. The removal has been made necessary by the tremendous increase in the volume of business handled through this office. The new location provides better facilities and has larger office space.

KENTUCKY ELECTRIC LAMP COMPANY, Owensboro, Ky., has broken ground for a new building, 60 x 100 ft. and three stories high. This company bought out the Kentucky Electric Company, Nov. 1, 1918. Its present output of lamps is 3000 per day and this is to be increased to 8500 lamps per day. The main building is to be completed about Oct. 1 and employment will be given to 150 people.

LAWRENCE F. PANKARD, who up to the time of enlisting in the national service, December, 1917, was New York manager of the Diehl Manufacturing Company, has acquired an interest in the Naumer Electric Company, 96 Beekman Street, New York. He has been elected vice-president of that company, which specializes in the application of motors for lithographing as well as general repairs and contracting work.

C. D. McCLARY, who has been with the Western Electric Company since February, 1910, has been made sales manager of the Pittsburgh office, effective July 1, 1919. Mr. McClary was first connected with the Philadelphia office and transferred to Pittsburgh in the latter part of 1910. In April, 1916, he joined the sales force, and in April, 1918, was promoted to assistant sales manager. He has held that position until his present promotion.

THE ELECTRIC AUTO-LITE CORPORATION, Toledo, Ohio, is to manufacture a 32-volt electric lighting and power plant for farm and other isolated uses. The system will be manufactured by one of the John N. Willys companies and will be known as the "Willys Light." It will be marketed through distributers and dealers throughout the United States and eventually throughout the world, and the formation of the sales organization is now under way. The company has bought the Poughkeepsie plant of the Fiat Company, from which it will handle its Eastern and export business.

THE DREW ELECTRIC & MANUFACTURING COMPANY of Indianapolis broke ground on July 11 for a new plant at Cleveland, where the company has acquired a two-acre site at Collamer Avenue and the Nickel Plate Railroad. The new plant will cost in the neighborhood of $50,000 and will include offices, machine shop and brass foundry. A separate building is to be erected as a hot galvanizing plant. The first building, which is 80 ft. by 200 ft., is scheduled for completion in forty-five working days from July 11. James H. Drew, president of the company, writes that the company expects to have the entire business moved to Cleveland by Sept. 1. This move is being made because Cleveland, being more nearly in the center of the company's business activities, affords better shipping and traveling facilities.

THE GEE ELECTRIC COMPANY has just opened a branch at Eighth Street, Huntington, W. Va. F. W. Connelly is manager.

SMITH & SERRELL is the new name for Smith-Serrell Company, Inc., manufacturers of shaft couplings, 93 West Street, New York City.

VAN RENSELAER LANSINGH, formerly general manager of the Holophane Company, has been elected president of the Lunken Window Company, Cincinnati.

ELECTROSE MANUFACTURING COMPANY, Brooklyn, N. Y., reports that Electrose insulators were used in the radio equipment of the NC-4 and the other NC boats.

MULTIPLE FUSE COMPANY, INC., with home office at 450 Fourth Avenue, New York City, has opened a branch sales office at 30 Euclid Arcade, Cleveland, O., with E. C. Newman in charge.

THE WESTINGHOUSE LAMP COMPANY announces that Elliot Reid, formerly advertising manager and more recently assistant to the general manager, became on July 1 sales manager of the company. In that capacity he will be

ELLIOT REID

responsible for the commercial activities of the company in both large and miniature classes of lamps in domestic territory. Mr. Reid was advertising manager of the company for six years. He became assistant to the general manager in November of last year. He was born in New York in 1889 and was connected with the Equitable Trust Company for three years.

Foreign Trade Notes

COLOMBIAN DEMAND FOR LIGHTING FIXTURES.—Colombian importers and dealers report a demand for lighting fixtures as high as 400 per cent greater than that of 1918.

JAPANESE ELECTRIC LAMP MANUFACTURING.—To meet the increased demand for electric light bulbs, a Japanese bulb-manufacturing concern is arranging for the installation of a la ge number of additional machines durin the present year.

POLAND'S ELECTRICAL REQUIREMENTS.—Committees formed from the industries of Poland have made an estimate of the immediate requirements of that country for electrical material as follows: Generators and transformers, 76,000-kw.; cables and wire, 2200 tons; telephone and telegraph apparatus and articles for electrical installations of every description.

RESTRICTIONS ON ENGLISH IMPORTS OF HOISTS.—The president of the Board of Trade has given directions that the importation of the following articles is to be licensed only exceptionally as and when required: Portable shop cranes, electric hoists and steel pulley blocks, except Yale triplex pulley blocks and Yale triplex electric hoists, which are to be rationed to regular pre-war importers at the rate of 100 per cent of the 1913 importations.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

Electric lighting appliances, lamps, etc., are required by a firm in Norway (No. 29,553). Payment, cash against documents.

Electrical machinery and supplies are required by an industrial corporation in Italy (No. 29,684). Correspondence may be in English.

A person in America (No. 29,535) who is soon to sail for Jugoslavia wishes to secure an agency for the sale in that republic of electrical goods.

A government engineer in Peru (No. 29,536) desires to receive catalogs from manufacturers of electrical fixtures and ornamental electric street lighting posts.

A merchant in Italy (No. 29,542) wishes to purchase or secure an agency for the sale of electrical equipment. Terms, payment on receipt of goods. Correspondence may be in English.

The purchase and agency are desired by a man in Italy (No. 29,567) of generators, motors, transformers and all electrical equipment and accessories. Payment, cash. Correspondence may be in English.

Trade Publications

HOUSEHOLD APPLIANCES. — These are described in catalog No. 28, published by J. H. Bunnell & Company, 32 Park Place, New York.

LAMP GUARDS.—A leaflet describing different sizes and styles of portable hand guards has been issued by Frank W. Morse, Inc., 89 Congress Street, Boston, Mass.

STORAGE BATTERIES.—The Universal Battery Company, 3410 South La Salle Street, Chicago, is distributing a leaflet describing the Universal starting battery.

ELECTRIC ROUTERS.—The construction and uses of electric routers are discussed in a leaflet issued by the Router Manufacturing Company, Oshkosh, Wis.

PAINTS AND VARNISHES.—The Shield brand of paints and varnishes is discussed in a leaflet put out by the Mitchell-Rand Manufacturing Company, 18 Vesey Street, New York.

VACUUM CLEANERS. — The United Electric Company, Canton, Ohio, is exhibiting a catalog and book of instruction for its line of cleaners, the Ohio-Tuec, Nos. 4 and 8.

ELECTRIC CRANES. — The Whiting Foundry Equipment Company, Harvey, Ill., has issued catalog No. 141, describing the operation and maintenance of the Whiting electric cranes.

RIVET HEATERS.—The American Car & Foundry Company, Berwick, Pa., has issued a leaflet describing electric rivet heating and the operation of the Berwick electric rivet heater.

TRANSFORMERS.—These are described in Bulletin 201 of the Packard Electric Company, Warren, Ohio. A section containing technical data on the operation of the transformers is included.

ELECTRIC TRUCKS.—Bulletin No. 15 of the Commercial Truck Company of America, Twenty-seventh and Brown Streets, Philadelphia, describes the company's four-wheeled internal-gear drive electric trucks.

LIGHTNING PROTECTION. — "One Hundred per Cent Lightning Protection" is the title of Booklet No. 137 put out by the Electric Service Supplies Company, 50 Church Street, New York, which contains information on the subject of lightning protection.

JACKS.—The "Simplex" jacks for pole pulling and pole straightening are illustrated in a booklet of Templeton, Kelly & Company, Ltd., Chicago, Ill., announcing the No. 325 "Simplex" automatic raising and lowering pole-pulling and pole-straightening jack.

ELECTRIC AIR HEATERS.—A folder being distributed by the American Electrical Heater Company, Detroit, describes the "American Beauty" electric air heater.

HOUSEHOLD APPLIANCES. — Julius Andrae & Sons Company, Milwaukee, Wis., has issued catalog No. 60, describing an extensive line of fans, lighting fixtures, lamps and washing and ironing machines.

FLOOD LIGHTING.—The Electric Service Supplies Company, 50 Church Street, New York, has issued an illustrated catalog describing its line of flood-lighting projectors. A feature of the booklet is a discussion of the functions and purposes of flood lighting.

New Incorporations

THE FREEDOM LIGHT & POWER COMPANY of Pemberville, Ohio, has been incorporated with a capital stock of $7,500 by F. William Daman and others.

THE SHANKSVILLE (PA.) ELECTRIC COMPANY has been incorporated with a capital stock of $5,000 by C. E. Fox, W. H. Fay and J. O. Lambert of Shanksville, Pa.

THE HADLEY (N. Y.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $25,000 by W. Fowler, J. H. Smead and J. J. Breen of Hadley.

THE DAVIS ELECTRICAL REPAIR & SALES COMPANY of Middlesboro, Ky., has been incorporated by J. H. Martin, H. H. Hutchinson and C. E. Davis. The company is capitalized at $10,000.

THE FRESH POND ELECTRIC COMPANY of Queens, N. Y., has been incorporated with a capital stock of $10,000 by J. Kreauser, P. F. Brion and P. R. Schoening, 718 Halsey Street, Brooklyn, N. Y.

THE SPENCER (OHIO) LIGHT & POWER COMPANY has been incorporated with a capital stock of $40,000 by George G. Bouthinon, George E. Roberts, Roy D. Elder, C. R. Aldrich and J. B. Firestone.

THE MORSE MAGNETO CLOCK COMPANY of New York, N. Y., has been incorporated by E. F. Howard, A. G. and J. S. Morse, 222 Riverside Drive, New York City. The company is capitalized at $25,000.

THE MORISON ELECTRICAL SUPPLY COMPANY of New York, N. Y., has been incorporated with a capital stock of $55,000 by A. H. Abbott, G. W. Harris and C. T. Morison, 515 West 187th Street, New York City.

THE MANHATTAN LAMP WORKS, of New York, N. Y., have been incorporated by Charles P. Leberthon, E. R. Geering and Martin Burkelman of Bloomfield. The company is capitalized at $10,000 and proposes to manufacture lamps, desk sets and novelties.

THE HALSTEAD WIRE COMPANY of Rome, N. Y., has been incorporated with a capital stock of $50,000 to manufacture metal and alloy wires and cables. The incorporators are J. P. Halstead, H. T. Dyett of Rome, and F. W. Wallace of Plainfield, N. J.

THE E. R. LILLIE CORPORATION of New York, N. Y., has been incorporated by H. W. Lillie of Greenwich, Conn.; L. Skipwith, Carnell Club, and R. J. Knoeppel, 5 Beekman Street, New York, N. Y. The company is capitalized at $25,000, and proposes to do a general electrical and mechanical contracting business.

THE SHIMEL-BAYER COMPANY of New York, N. Y., has been incorporated by Joseph Shimel, Lena Shimel and Louis Bayer, 83 West 118th Street, New York City. The company is capitalized at $20,000 and proposes to do a general electrical supply and installation business.

THE NATIONAL STANDARD COMPANY OF CANADA, LTD., has been incorporated by Charles H. C. Leggott, 116 Arundel Avenue; Walter W. Perry of Scarboro Junction, Ont., and others. The company is capitalized at $30,000 and proposes to manufacture wire, cables, lightning rods, wire machinery, tools, etc.

THE NEW-BAR CHANDELIER & ELECTRICAL CORPORATION, of New York, N. Y., has been incorporated with a capital stock of $2,000 to deal in electrical and gas fixtures and to do general electrical contracting business. The incorporators are H. M. Newmark, B. Newmark, and Isidor Barnett, 1379 St. John's Place, Brooklyn, N. Y.

New England States

WINN, ME.—The Public Utilities Commission has granted the Penobscot Light & Power Company permission to issue and sell at not less than par $10,000 in capital stock. The proceeds will be used for the erection of pole line and distribution system, etc. The company was recently organized to supply electricity for lamps, heaters and motors in Winn and Mattawamkeag.

BROCKTON, MASS.—Preparations are being made by the Edison Electric Illuminating Company of Brockton for the installation of an ornamental street-lighting system in the business district.

LYNN, MASS.—Arangements are being made by the Board of Water Commissioners for the construction of a new electrically driven pumping station at Hawkes Pond, to cost about $15,000.

NEW BEDFORD, MASS.—Plans are being prepared for the erection of a new factory building on Coggeshall Street, to cost about $100,000, for the Fairhaven Mills. The new building will be equipped with electric motor-driven machinery, etc.

TAUNTON, MASS.—The Electric Light Commission is considering the question of using oil instead of coal for fuel at the municipal electric light plant.

DANBURY, CONN.—Arrangements are being made by the Danbury & Bethel Gas & Electric Light Company to secure electricity from the large electric power plant now under construction by the Connecticut Light & Power Company of Waterbury on the Housatonic River at Stevenson. Work, it is understood, will soon begin on the erection of a transmission line, 16 miles long, to connect this city with the power plant. The cost of the proposed line is estimated at about $150,000.

HARTFORD, CONN.—Plans have been filed by Case & Marshall for the erection of a power house at its works, located in the Burnside district. Contract for the building has been awarded to the J. H. Grozier Company of Hartford, Conn. The cost is estimated at $10,000.

PUTNAM, CONN.—Contract has been awarded by the Nightingale-Morse Mills, Inc., for the construction of a hydroelectric power plant to the H. Wales Lines Company of Meriden. Alterations will also be made in the present mill buildings, including the laying of foundations for machinery.

Middle Atlantic States

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company has acquired a site at the corner of Kent Avenue and South Sixth Street, on which it proposes to erect a new power plant.

BROOKLYN, N. Y.—Bids will be received by Lindley M. Garrison, receiver of the New York Municipal Railway Corporation, 85 Clinton Street, Brooklyn, until July 28 for tunnel lighting equipment and station lighting, heating and toilet ventilating systems in portions of the Broadway-Fourth Avenue line. Plans and further information may be obtained at the above office.

BUFFALO, N. Y.—Bids will be received by the superintendent of lighthouses, Buffalo, N. Y., until July 21 for furnishing 4200 linear ft. of lead-incased submarine cable.

MACEDON, N. Y.—At an election held recently the proposal to issue bonds for the purchase of the local electric light plant, to be owned and operated by the municipality, was carried.

MONTAUK, N. Y.—All bids received June 25 for the construction of power house at the local naval station have been rejected by the Bureau of Yards and Docks, Navy Department, Washington, D. C.

NEW YORK, N. Y.—Plans have been filed by the New York Edison Company for the erection of a building, 25 ft. by 75 ft., two stories, at Hester and Norfolk Streets, to cost about $35,000.

NEW YORK, N. Y.—The Public Service Commission has granted the Long Island Lighting Company, 50 Church Street, New York City, permission to issue $80,000 in capital stock and $180,000 in bonds, the proceeds to be used for extensions and improvements to its system. The company operates electric generating stations at Northport, Amityville, Sayville, Babylon and Islip, N. Y.

PIERREPONT MANOR, N. Y.—The Northern New York Milk Company is planning to establish a milk station, including an ammonia ice plant, an evaporating plant and milk-shipping station in Pierrepont Manor, to cost about $200,000. The proposed plant will be equipped with electric motor-driven machinery. F. P. Redfield Adams is reported to be interested in the company.

SYRACUSE, N. Y.—Contract has been awarded by W. S. Hoffman, 329 Tuckel Street, to Dawson Brothers, Union Building, for the construction of its new foundry, 50 ft. by 200 ft. A power plant will be erected in connection with this addition to supply power for the works. The cost of the entire work is estimated at about $50,000.

TRENTON, N. J.—The proposed new sewage-disposal plant now under consideration by the City Commission will be equipped with electrically driven pumps and other electrical equipment. The cost of the first unit is estimated at about $500,000.

TRENTON, N. J.—Contract for the construction of the proposed new hospital buildings by the state officials has been awarded to the Standard Construction Company, 1713 Sansom Stret, Philadelphia, Pa. A large amount of electrical equipment will be required. The cost of the work is estimated at about $300,000.

DAMASCUS, PA.—The installation of a municipal electric light plant in Damascus is under consideration.

EASTON, PA.—Plans have been completed by the Pennsylvania Utilities Company for the installation of three new boilers, one of 1000 hp. and two of 650 hp. each, equipped with underfeed stokers, at its local plant.

MEADVILLE, PA.—The car barns and equipment of the Northwestern Pennsylvania Railway Company were recently destroyed by fire, causing a loss of about $60,000.

PHILADELPHIA, PA.—Plans have been prepared for the erection of a boiler house in connection with the new plant to be erected by the Griffon Company at Unity and Oakland Streets, at a cost of about $100,000.

SALISBURY, MD.—New equipment, including boiler, engine, power plant and general operating apparatus, will be installed in the new plant of the Salisbury Ice Company.

PARKERSBURG, W. VA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 30 for furniture, lighting fixtures, etc., for the United States post office and court house at Parkersburg. For details see Searchlight Section.

WILLIAMSTOWN, W. VA.—The installation of a new street-lighting system is under consideration.

CLIFTON FORGE, VA.—The capital stock of the Virginia-Western Power Company has been increased from $1,000,000 to $1,250,000.

LYNCHBURG, VA.—Plans are under consideration by the Southern Electric Steel Company, Scott Building, for the erection of a foundry, 90 ft. by 120 ft., one story, to cost about $50,000. J. N. Keyser is president.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until July 22 for furnishing at the Brooklyn Navy Yard 79,000 ft. rubber-covered wire, miscellaneous lighting and power cable, and also lead and rubber-covered wire.

WASHINGTON, D. C.—Bids will be received by the Machinery and Enginering Materials Division, Munitions Building, Washington, D. C., until July 25, for furnishing miscellaneous signal supplies, including expansion anchors, conduit, conduit bushings, supporters, porcelain cleats, porcelain knobs, etc. Further information may be obtained at the above office.

WASHINGTON, D. C.—Bids will be received by the chairman of Board of Awards, Department of Agriculture, Washington, D. C., until July 25 for furnishing and installing in the department power plant at Wasnington, D. C., one compound, three-wire, 115/230-volt, direct-current generator, geared to a steam turbine. Specifications may be obtained at the above office.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

North Central States

ADRIAN, MICH.—Plans are being considered by the Schwarze Electric Company for the construction of an addition to its manufacturing plant, 100 ft. by 100 ft., to cost about $20,000.

GRAND RAPIDS, MICH.—Bids will be received by Herbert N. Morrill, business manager of board of education, City Hall, Grand Rapids, until July 31 for construction of new Congress School, including general construction work, heating and ventilating, plumbing and sewering, electrical work, vacuum cleaning apparatus, etc. Plans and specifications are on file at the office of Henry H. Turner, 234 Division Avenue, Grand Rapids, Mich.

MUSKEGON, MICH.—The Continental Motors Corporation is planning to erect a manufacturing building and power plant in Muskegon and to replace the machinery in its present building with new equipment. The cost of the proposed work is estimated at about $1,000,000.

STANWOOD, MICH.—A company has been organized by M. D. Crane, E. L. Smith and others to construct and operate an electric light plant in Stanwood.

AKRON, OHIO.—Bids will be received at the office of the director of public service, Delaware Building, Akron, until Aug. 1 for furnishing two horizontal centrifugal pumps, normal capacity 1000 gal. per minute against a total head of 80 ft., directly connected to electric motors. Specifications may be obtained from the Bureau of Waterworks Improvement, 102 East Mill Street, Akron. G. G. Dixon is engineer, and H. H. Frost is superintendent of waterworks.

BUCYRUS, OHIO.—The City Council is considering the installation of an ornamental lighting system in additional streets in the down town section.

CLEVELAND, OHIO.—Contracts, it is understood, will soon be awarded by the Cleveland Illuminating Company for the construction of a garage at 6500 Cedar Avenue, to cost about $60,000. P. H. Cobb, Illuminating Building, is architect.

CLEVELAND, OHIO. — The Electric Vacuum Cleaner Company, recently incorporated, with a capital stock of $1,400,000, has taken over the plant and the business of the Frantz Premier Company of Cleveland and the electric vacuum-cleaner department of the Edison Electric Appliance Company of Chicago, Ill. The company is affiliated with the General Electric Company. Julius Ruteur is president.

MANSFIELD, OHIO.—Plans are being prepared for the installation of a new 10,000-kw. turbine at the central station of the Richland Public Service Company at Melco, 11 miles from Mansfield. The cost of the proposed improvements is estimated at about $350,000. The Richland company is controlled by the Cities Service Company.

ANDERSON, IND.—The Public Service Commission has instructed the Union Traction Company of Indiana to rehabilitate its power plant at Anderson. The commission ordered the completion of repairs to the plant now under way completed as soon as possible and also the installation of additional equipment.

PETERSBURGH, IND.—The new tipple which is being erected at the mine of the Gladstone Coal Company, near Petersburg, will be operated by electricity.

CAIRO, ILL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Aug. 8, for a new motor-driven triplex pump, etc., in the United States post office and custom house at Cairo.

CHICAGO, ILL.—Plans are being prepared by A. A. Salzman Engineering Company, 30 North La Salle Street, for the erection of an cold storage plant for the Mid City Cold Storage Company, to cost about $1,000,000.

EAST ST. LOUIS, ILL.—The plant of the East St. Louis Light & Power Company was recently damaged by fire, causing a loss of about $60,000.

MARION, ILL.—The installation of an ornamental lighting system in Marion is under consideration.

SPRINGFIELD, ILL.—The construction of an electric railway between Springfield and Rushville, via Petersburg and Chandlersville, is under consideration. John Rosenwienkyle, 2145 North Racine Avenue, Chicago, is interested.

VILLA GROVE, ILL.—Steps have been taken to organize a company to construct and operate an electric light plant in Villa Grove.

BELOIT, WIS.—Plans have been adopted by the City Council for the installation of an ornamental lighting system on the principal business streets of the city. The public works committee has been instructed to advertise for bids for material and for installation of the system. Arthur J. Sweet of Milwaukee will superintend the installation of the proposed system.

GALESVILLE, WIS.—The Davis Mill Company is contemplating the installation of a new lighting system, changing from the direct to alternating-current system. The company is planning to extend its lines several miles in different directions to supply other communities with electricity for lamps and motors.

HUDSON, WIS.—The Burkhardt Milling & Electric Power Company of Hudson has awarded Bain & Robb of Milwaukee and Minneapolis, Minn., a contract for construction of power house and equipment to cost about $25,000, and also for the installation of a vacuum central-station steam-heating system, at about $18,665.

PESHTIGO, WIS.—Plans have been prepared for the construction of a new paper mill and separate power plant for the Peshtigo Pulp & Paper Company, to cost about $250,000. The company was recently organized with a capital stock of $500,000. Samuel Woodward is secretary.

PORT WASHINGTON, WIS.—Plans are being prepared by Douglas & Cahill, engineers, Gross Building, Milwaukee, for addition to the municipal power house, 20 ft. by 40 ft., to cost about $30,000.

DULUTH, MINN.—The City Council has adopted a resolution providing for improvements to the lighting sysetm. It is proposed to replace the arc lamps with new units and erect eight lamps to the block. The Duluth Edison Electric Company has the contract for street lighting.

MONTEVIDEO, MINN.—Bids will be received by the City Council of Montevideo until July 28 for improvements and extensions to the municipal waterworks system, including construction of reservoir, one 750-gal.-per-minute centrifugal pump with motor, switchboard, piping, etc., hydrants, valves, cast-iron pipe, etc. W. E. Skinner, is consulting engineer.

MORRIS, MINN.—Bids will be received by the Minnesota State Board of Control, State Capitol Building, St. Paul, until July 24, for construction of a boys' dormitory, including heating and ventilating, electrical work and plumbing, at the West Central School of Agriculture at Morris. C. H. Johnson, 715 Capital Bank Building, St. Paul, is architect.

WINDOM, MINN.—The contract for the central-station vacuum steam-heating system, to be operated in connection with the municipal electric lighting plant for heating the business district, has been awarded to Bain & Robb of Milwaukee, Wis., and Minneapolis, Minn., at $41,088.

EAST ST. LOUIS, MO.—The East St. Louis & Suburban Railway Company will purchase a 60-cycle turbine, switchboard and other electrical equipment to replace machinery destroyed and damaged by an explosion.

NORBORNE, MO.—The property of the Norborne Fuel, Ice & Light Company has been purchased by the Water, Light & Transit Company of Carrollton. The latter company is planning to erect an electric line from Carrollton to furnish electricity here.

ST. JOSEPH, MO.—The City Council has engaged W. J. Squires of Kansas City to prepare plans for improvements to the municipal electric light plant.

BERESFORD, S. D.—The proposal to issue $5,000 in electric light bonds will soon be submitted to the voters.

FAIRMONT, NEB.—A special election will soon be called to submit to the voters the proposal to issue $35,000 in bonds for the purchase of the plant of the Fairmont Water & Light Company.

LINCOLN, NEB.—Plans are under consideration to install a new power plant at the University of Nebraska Medical College, to cost about $60,000.

LINCOLN, NEB.—The State Fair Board is negotiating with the City Council relative to the extension of the municipal electric lighting system to the State Fair Grounds, a distance of 1½ miles.

ALTAMONT, KAN.—At an election held recently the proposal to issue $25,000 for the installation of an electric light plant in Altamont was defeated.

SHARON SPRINGS, KAN.—Plans are being prepared by Black & Veatch, engineers, Interstate Building, Kansas City, Mo., for the construction of a municipal electric light plant in Sharon Springs.

Southern States

EAST POINT, GA.—Couch Brothers of East Point have entered into a contract with the Georgia Railway & Power Company of Atlanta for an additional load of 150 kw. for its new mill, now under construction, in addition to the existing load of 110 kw. The power company will erect at East Point a new nigh-tension substation, replacing the service formerly rendered to Couch Brothers from the 2300-volt feeder.

KEY WEST, FLA.—All bids submitted June 25 for construction of power house, electric generating equipment and fire protection system at the Key West Navy Yard have been rejected by the Bureau of Yards and Docks, Navy Department, Washington, D. C.

NASHVILLE, TENN. — Improvements are contemplated to the municipal electric light plant, involving an expenditure of about $48,000. The installation of an ornamental lighting system on Main Street from Church Alley to Railroad Street is under consideration.

ALBANY, ALA.—The City Council has granted the Alabama Power Company, which controls the Alabama Traction, Light & Power Company, a thirty-year franchise upon the condition that the transmission lines of the Alabama Power Company are extended to this city within the next three years. This, it is stated, will be done at a cost of several hundred thousand dollars. The proposed line will probably be extended through Huntsville.

COURTLAND, ALA.—The Farmers and Merchants' Ginning Company of Courtland recently organized, is planning to operate an electric lighting plant in connection with the proposed cotton gin. The company is capitalized at $30,000.

HUNTSVILLE, ALA. — The Alabama Power Company of Birmingham has awarded a contract to the Dixie Construction Company for the erection of an electric transmission line from Gadsden to Huntsville, via Albertville and Guntersville. The cost of the line is estimated at about $200,000.

MOBILE, ALA. — The Mobile Electric Company is reported to be in the market for a 750-kw. or 1000-kw. direct-current motor-generator, 250-volt, three-wire machine preferred; alternating-current side, 2200/2400-volt, three-phase, 60-cycle synchronous motor to operate above at 70-80 per cent power factor.

MARVEL, ARK.—The capital stock of the Marvel Light & Ice Company has been increased from $20,000 to $40,000.

MONROE, LA.—The City Commissioners are considering calling an election in October to submit to the voters the proposal to issue $2,000,000 in bonds for public improvements. The proposed work will include a new electric power station, water works with filtration plant, drainage system, extensions and improvements to sewer system, garbage disposal plant, wharf and elevator, street paving, etc. Walter G. Kirkpatrick is consulting engineer and director of public works.

OKEMAH, OKLA.—Bonds to the amount of $50,000 have been voted for improvements to the municipal electric light plant and $23,000 in bonds for waterworks improvements.

TULSA, OKLA.—Arrangements are being made by the Public Service Corporation of Oklahoma for the construction of a new electric generating plant, to cost about $731,500. The proposed plant will be located on the west bank of the Arkansas River, near the Midland Valley Railway, which is building a spur to the site. Contracts for the machinery, it is understood, have been placed ,and the building contracts are pending.

DALLAS, TEX.—The Dallas Power & Light Company is planning to build a substation in Dallas. The company has been granted a franchise by the City Commission to erect a high-tension transmission line to connect with the substation.

RANGER, TEX.—The Ranger Light & Power Company, which has been granted a franchise for a street railway system here by the City Commission, is contemplating the construction of a system of interurban electric railways through the central west Texas oil fields. The first interurban line to be built will run between Ranger and Eastland, a distance of 12 miles. The company is planning to erect a large power plant here.

SAN ANTONIO, TEX.—At an election to be held soon the proposal to issue $150,000 in bonds for the installation of a fire-alarm system will be submitted to the voters.

Pacific and Mountain States

TACOMA, WASH.—The City Council has chosen the Lake Cushman site on the Skohomish River. A special election will be held on Aug. 12 to submit to the voters the proposal to issue $300,000 in bonds to purchase the property. It is estimated that 75,000 hp. can be developed at the Lake Cushman site.

FOSSIL, ORE.—The Fossil Milling Company, which supplies electrical service in Fossil, is changing its system from direct to alternating current.

LOS ANGELES, CAL.—The Goodyear Tire & Rubber Company of Akron, Ohio, has acquired a site of about 600 acres at Ascot Park, near Los Angeles, on which it proposes to erect a new plant for the manufacture of automobile tires. A California corporation of the same name, capitalized at $20,000,000, will be organized to construct and operate the new works, which will consist of a group of buildings to include every department of operation, as well as an electric power station. The entire cost is placed at about $4,000,000. The Pacific Cotton Mills, capitalized at $6,000,000, will be organized as a subsidiary, to construct another factory group on an adjoining site for the manufacture of fabric for tire production, to cost with equipment about $1,500,000. The entire property will be laid out as a new industrial city, and the works will give employment to about 3700 for the initial operations.

VERNON, CAL.—The contract for the buildings for the new packing plant of the California Provision Company of Los Angeles to be erected at Vernon has been awarded to Charles B. Harp, 1102 Baker-Detwiler Building, Los Angeles. The works will consist of a number of buildings, including a boiler plant and also a refrigerating plant. The cost is estimated at about $125,000, of which $75,000 will be expended for equipment.

RONAN, MONT.—The Flathead Valley Electric Company, recently incorporated with a capital stock of $25,000, is planning to erect electric light and power plants at points in the Flathead Valley. The main office of the company will be in Ronan. The directors are Andrew Anderson of Plains, Mont.; Mahlon McCain, Leo Fausten and F. M. Shields of Spokane, Wash.

Canada

WINNIPEG, MAN.—The Winnipeg River Power Company has started work on the construction of a power plant at Du Bonnet Falls on the Winnipeg River, about 75 miles from Winnipeg. The plans call for a development of 168,000 hp. at a cost of about $7,000,000. The Mackenzie and Mann interests of Toronto are reported interested in the company.

BERWICK, N. S.—Contracts will soon be awarded by the Town Council for construction of dam, flume and other improvements to the municipal electric light plant. Bonds to the amount of $27,500 have been sold for the work.

SYDNEY, N. S.—The Cape Breton Electric Company is contemplating the construction of an extension from Glasgow to New Waterford.

BELLEVILLE, ONT.—The Hydro-Electric Power Commission of Ontario has decided to erect a 44,000-volt tie line from Healey Falls to Peterboro this season, which will enable Havelock, Norwood and Hastings to secure Hydro-Electric service.

BRANTFORD, ONT.—The Electric Tin Products Company is planning to establish a plant in Brantford. An electric smelting system will be used.

HAMILTON, ONT.—The Dominion Foundry Company is contemplating the installation of electric ovens at its plant.

TEESWATER, ONT.—Plans are being prepared for the installation of an electric distribution system. Power will be obtained from the Hydro-Electric Power Commission of Ontario. A. Flint, 190 University Avenue, Toronto, is engineer. For further information address J. A. Constantine of Teeswater.

TORONTO, ONT.—The Northern Aluminum Company, 158 Sterling Road, is planning to erect an eight-story building, 60 ft. by 280 ft., to cost about $450,000. C. A. P. Turner, 38 South Dearborn Street, Chicago, Ill., is engineer.

DONNACONNA, QUE.—Bids are being received for the construction of a 150-ton pulp and paper mill at Donnaconna and for a power plant on the Jacques River to develop 5000 hp. Plans and specifications may be obtained upon application to "Pulp and Paper," Room 40, Toronto Exchange Building, Toronto, Ont.

(Issued July 1, 1919)

14,677 (reissue). BOX FOR ELECTRIC METERS; John V. Becka, Cleveland, Ohio. App. filed Jan. 28, 1919. Affords protection.

14,680 (reissue). LIGHTING FIXTURE; Edwin F. Guth, St. Louis, Mo. App. filed Oct. 21, 1913. Even distribution of light, not only permitting some of the light to pass downward but also directing a portion of it outwardly toward the walls of the room.

1,308,023. PERCOLATOR; Theodore Abtmeyer, Wilkinsburg, Pa. App. filed March 28, 1913. Thin annular column of liquid is isolated for heating.

1,308,032. FLASHLIGHT; Bernard Benedict, New York, N. Y. App. filed Feb. 7, 1914.

1,308,040. LIQUID-HEATING METHOD AND APPARATUS; Lewis W. Chubb, Edgewood Park, Pa. App. filed June 30, 1915.

1,308,041. METHOD OF AND APPARATUS FOR PRODUCING ASYMMETRIC POTENTIAL WAVES; Lewis W. Chubb, Edgewood Park, Pa. App. filed July 14, 1915. Producing high-potential electrical impulses or discharges in one direction only.

1,308,042. FUSE FOR ELECTRIC CIRCUITS; Henry M. Cogan, Brooklyn, N. Y. App. filed April 13, 1917. Refillable.

1,308,043. CONTROLLER; Joel R. Cook, Wilkinsburg, Pa. App. filed July 6, 1915. For efficiently controlling the operation of electric motors.

1,308,048. ELECTRICAL DEVICE; Leslie N. Crichton, Wilkinsburg, Pa. App. filed April 5, 1916. Indicates phase-angular relations in electric circuits.

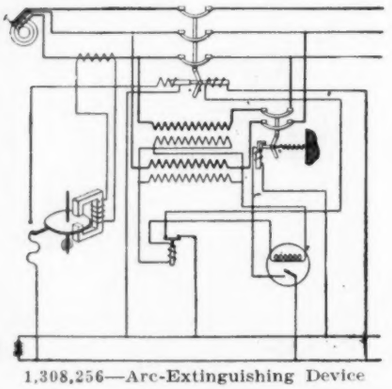
1,308,059. DISTRIBUTING SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed May 14, 1915. Protective means for systems that are exposed to transient disturbances.

1,308,061. GAS-ENGINE-CONTROLLING MECHANISM; John E. Gilson, Port Washington, Wis. App. filed May 17, 1915.

1,308,064. COIL-INSULATING DEVICE; Israel L. Griffith, Pittsburgh, Pa. App. filed June 4, 1915. Cells interposed between the coils and the walls of the slots.

1,308,068. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Oct. 7, 1915. Phase-advancing means for effecting power-factor regulation of polyphase induction motors.

1,308,069. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed May 2, 1917. Plurality of main momentum-driven dynamo-electric machines.



1,308,256—Arc-Extinguishing Device

1,308,070. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed April 18, 1917. Braking or retarding of a momentum-driven vehicle by the use of both electrical and mechanical braking systems.

1,308,076. STARTING COUPLING FOR HIGH-TENSION MAGNETOS; Frederick H. Horning, Chicago. App. filed Jan. 30, 1915.

1,308,087. STARTING DEVICE FOR ARC LAMPS; George M. Little, Pittsburgh, Pa. App. filed May 11, 1914. For causing the electrodes of arc lamps to move into and out of engagement for the purpose of removing the insulating deposits.

1,308,089. CONTROL SYSTEM; Paul L. Mardis and Arthur J. Hall, Wilkinsburg, Pa. App. filed June 13, 1917. Excitation varied automatically and at will under the control of a main controller governed by a master switch.

1,308,094. SYSTEM OF CONTROL; Friedrich W. Meyer, Pittsburgh, Pa. App. filed March 24, 1915. Speed of a railway vehicle may be economically controlled.

Record of Electrical Patents

Notes on United States Patents

1,308,106. SYSTEM OF CONTROL; Laurence M. Perkins, Wilkinsburg, Pa. App. filed March 7, 1916. Motor-generator set excites the field windings of the momentum-driven machines.

1,308,120. PROTECTIVE DEVICE FOR TROLLEY SYSTEMS; Karl A. Simmon, Edgewood Park, Pa. App. filed Aug. 28, 1915.

1,308,127. TERMINAL DEVICE FOR ELECTRIC APPLIANCES; Frank Thornton, Jr., Pittsburgh, Pa. App. filed Nov. 7, 1916. Several different combinations of conductors may be obtained.

1,308,158. ELECTRICAL APPARATUS; Joseph Bijur, New York, N. Y. App. filed Nov. 18, 1914. For use in starting internal-combustion engines.

1,308,172. CIRCUIT CONNECTOR; Harry A. Douglas, Bronson, Mich. App. filed Oct. 24, 1917. Tubular shells.

1,308,200. DISPLAY APPARATUS; Thomas W. Small, Cleveland, Ohio. App. filed May 26, 1915.

1,308,211. ELECTRIC HEATER; Edward Walder, Kansas City, Mo. App. filed Oct. 7, 1918. Portable.

1,308,214. ELECTRICAL CONNECTION; Wilbur H. Young, Keyport, N. J. App. filed March 19, 1913. Quickly applied to a brush.

1,308,229. MOTOR-CONTROL SYSTEM; Edward I. Deutsch, Cincinnati, Ohio. App. filed June 13, 1917. Operates motor in opposite directions for the respective operations and for effecting the dynamic braking.

1,308,230. STORAGE BATTERY; Samuel Diller, Des Moines, Iowa. App. filed Oct. 16, 1917.

1,308,235. IGNITION MECHANISM FOR INTERNAL-COMBUSTION ENGINES; Harry F. Geist, Racine, Wis. App. filed Sept. 20, 1915.

1,308,249. ARC-EXTINGUISHING DEVICE; Paul MacGahan, Pittsburgh, Pa. App. filed Aug. 7, 1916. Alternately opens and closes a circuit interrupter to reduce the voltage of the circuit so that the arc will be extinguished without causing the apparatus connected to the circuit to fall out of synchronism.

1,308,256. ARC-EXTINGUISHING DEVICE; Raymond T. Pierce, Wilkinsburg, Pa. App. filed Feb. 4, 1918. Alternately opens and closes a circuit interrupter to reduce the voltage of the circuit so that the arc will be extinguished without causing the apparatus connected to the circuit to fall out of synchronism.

1,308,257. ARC EXTINGUISHER; Forrest E. Rickets, Baltimore, Md. App. filed March 13, 1916. Prevents the automatic opening and closing of the interrupter if the arc is not extinguished within a predetermined time.

1,308,273. ELECTRIC FURNACE; James Bibby, London, Eng. App. filed March 6, 1919. Divided-ring device in which all the segments incline inwardly and downwardly and act by gravity to surround closely and bear against the electrode.

1,308,274. RAILWAY LIGHTING APPARATUS; Joseph Bijur, New York, N. Y. App. filed Dec. 1, 1910. Carbon-pile resistance.

1,308,275. AUTOMATIC CUT-OUT FOR ELECTRIC GENERATORS; Henry E. Borger, Newark, N. J. App. filed Aug. 24, 1917.

1,308,284. AUTOMOBILE SIGNAL; Jackson C. Hoyt, Denver, Col. App. filed Sept. 29, 1916. Hand-operated.

1,308,305. MOTOR-DRIVEN MACHINE FOR MANUFACTURE OF BOOTS AND SHOES; Frank J. Spencer and William J. Kelly, Leicester, Eng. App. filed March 16, 1916. Electrical apparatus for obtaining and imparting oscillations of high frequency.

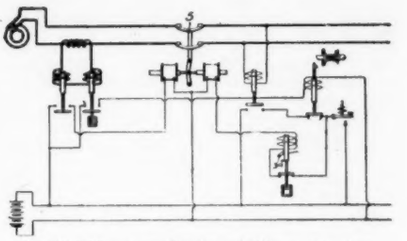
1,308,341. PROCESS OF MAKING ELECTRICAL CONDENSERS; William C. Brinton, Jr., Kennett Square, Pa. App. filed July 20, 1917.

1,308,365. ARC-EXTINGUISHING DEVICE; Paul MacGahan, Pittsburgh, Pa. App. filed Aug. 10, 1916. Alternately opens and closes a circuit interrupter to reduce the voltage of the circuit so that the arc will be extinguished without causing the apparatus connected to the circuit to fall out of synchronism.

1,308,388. DETECTIVE AND PROTECTIVE DEVICE FOR ELECTRIC CABLES; Charles J. Beaver, Hale, Eng. App. filed Sept. 25, 1918. Detects defects at an early stage and provides for automatic cutting out in case of serious leakage.

1,308,389. SHEATH COUPLING FOR ELECTRIC CABLES; Charles J. Beaver, Hale, Eng. App. filed Oct. 30, 1918. For containing the joints of sections.

1,308,390. SHEATH COUPLING FOR ELECTRIC CABLES; Charles J. Beaver, Hale, Eng. App. filed Nov. 7, 1918. Bridges a subsidiary conductor across a joint in a cable.



1,308,365—Arc-Extinguishing Device

1,308,399. ELECTRIC METAL-WORKING APPARATUS; George A. Cutter, Dedham, Mass. App. filed Nov. 4, 1918.

1,308,423. ELECTRICAL SWITCH; Bryson D. Horton, Detroit, Mich. App. filed March 24, 1915. Operates blades of three-pole switch separately.

1,308,424. ELECTRICAL SWITCH; Bryson D. Horton, Detroit, Mich. App. filed July 13, 1916. Switch mechanism in which three or more spaced-apart pairs of co-operating contacts are provided.

1,308,448. RECTIFYING ALTERNATING CURRENTS; Henry K. Sandell, Chicago, Ill. App. filed June 18, 1917. Transformer especially designed for use in connection with the rectifying systems.

1,308,435. DRIVE FOR PUMPS; Auguste Maire, Route de Bezons, Argenteuil, France. App. filed Feb. 18, 1918. Permanent magnet caused to rotate by the magnetic flux which passes through the sides of the box.

1,308,449. ELECTRIC MOTOR AND GOVERNING MECHANISM THEREFOR; Henry K. Sandell, Chicago, Ill. App. filed July 14, 1917. Low speed.

1,308,503. IGNITION-MAGNETO SWITCH FOR INTERNAL-COMBUSTION ENGINES; Giuseppe di Pietro Martire, Milan, Italy. App. filed May 21, 1918.

1,308,508. PLATING HOOK; Otto Roedel, Jersey City, N. J. App. filed Sept. 4, 1918.

1,308,509. PROCESS FOR THE PURIFICATION OF ALKALI-METAL-CHLORIDE SOLUTIONS; Claus N. Riiber, Trondhjem, Norway. App. filed Dec. 12, 1918.

1,308,514. TRANSMITTING APPARATUS FOR WIRELESS TELEGRAPHY AND TELEPHONY; Georg von Arco and Alexander Meissner, Berlin, Germany. App. filed March 6, 1914.

1,308,518. FUSE PLUG; Walton D. Woolley, Chicago, Ill. App. filed July 17, 1917.

1,308,530. CONTROLLING WIRELESS-TELEGRAPH TRANSMITTERS; Gustav Reuthe, Sayville, N. Y. App. filed May 25, 1916.

1,308,539. NUMBER-INDICATING MEANS; Henry P. Clausen, Mount Vernon, N. Y. App. filed Nov. 21, 1916.

1,308,551. RACK FOR SHOES AND THE LIKE; Edgar Millner, St. Louis, Mo. App. filed April 27, 1918.

1,308,553. TELEPHONE-EXCHANGE SYSTEM; Winfred T. Powell, Chicago, Ill. App. filed July 24, 1916.

1,308,554. CALL-DISTRIBUTING SYSTEM; Ralph L. Quass, Hawthorne, N. J. App. filed Oct. 8, 1917.

1,308,567. MAGNETIC INDUCTOR; James M. Wilson, Newark, N. J. App. filed Jan. 5, 1917.

1,308,585. METHOD AND APPARATUS FOR ADJUSTING ARMATURES OF ELECTROMAGNETIC DEVICES; Clinton O. Harrington, Edgewood Borough, Pa. App. filed Jan. 17, 1917. Gives a predetermined torque to the armature.